UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

December 3, 2013

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**MEMORANDUM**

**SUBJECT:** Problem Formulation for the Environmental Fate and Ecological Risk, Endangered Species, and Drinking Water Assessments in Support of the Registration Review of Picloram

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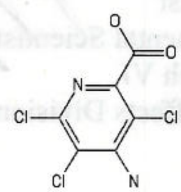
United States Environmental Protection Agency

**Office of Chemical Safety and Pollution Prevention**

# Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Exposure Assessments in Support of the Registration Review of Picloram



4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid
CAS Registry Number: 1918-02-1
PC Code: 005101, 005102, 005104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# 1. Executive summary

The Environmental Fate and Effects Division (EFED) has completed the preliminary problem formulation for the ecological risk, environmental fate, endangered species, and drinking water assessments to be conducted as part of the registration review of picloram. This action includes triisopropanolamine picloram (TIPA-salt), potassium picloram (K-salt), and picloram acid (picloram). Isooctyl/ethylhexyl picloram is not included in this action as there are no current registrations for the active ingredient. The problem formulation describes the methods planned to be used during the completion of drinking water and ecological risk assessments in support of registration review and provides an overview of the environmental fate, ecological effects, and potential risks associated with the use of picloram as well as uncertainties unique to the risk assessment of picloram. This document also identifies additional studies that would be beneficial to the conduct of an ecological risk assessment. Major findings include:

The following environmental fate data gaps exist for picloram:

- **Adsorption/Desorption (OCSPP Guideline 835.1230)**: Accurate quantification of sorption coefficients is highly important for a compound with high expected mobility. Current reported estimates are derived from Footprint, a database associated with the European Food Safety Administration for which the supporting data are not available.
- **Prospective Groundwater Study (OCSPP Guideline 835.7100):** The leaching of picloram to groundwater and the subsequent use of that groundwater is a complete exposure pathway with effects to non-target plants and five reported incidents. The veracity of these incidents is confirmed by comparing a screening level groundwater concentration from PRZM-GW of 0.421 mg a.e./L to the most sensitive available terrestrial plant endpoint (vegetative vigor tomato NOAEC = 0.00016 lb a.e./ac) . Less than 1/500$^{th}$ of an inch of irrigation water would be required to reach this endpoint. Furthermore, less than one inch of irrigation water would be required to reach the vast majority of reported terrestrial plant endpoints. A prospective groundwater study performed in an area representative of typical picloram use conditions would allow for better characterization of expected groundwater concentrations and may demonstrate potential mitigations such as well setback distances or minimum well depths. Terrestrial field dissipation studies only characterize dissipation up to 60 inches below the surface and cannot effectively inform these mitigation decisions.
- **Environmental Chemistry Methods and Independent Laboratory Validation on Soil, Water, and Compost (OCSPP Guideline 850.6100):** Pending review of environmental chemistry methods on soil and water (MRIDs 45366 and 69078), the data is requested. Data is also requested for environmental chemistry methods on compost and independent laboratory validation of soil, water, and compost. For compost, methods should be derived that can be used with equipment found in state laboratories and use laboratory standards that can be readily obtained. LOQs for ECMs need to be low enough to detect residues that could cause a risk concern (*i.e.* need to be below the most sensitive toxicity endpoints reported in this document).
- **Dissipation study in compost (Non-Guideline):** The application of picloram to vegetative matter that is subsequently used as compost or animal feed has been found to retain picloram residues and affect non-target plants (see Section 6.3). This route of

exposure is common across the picolinc acid herbicides (aminopyralid, clopyralid, and picloram). A study is requested to demonstrate the rates of degradation and leaching in vegetative and manure composts. The study will be used to characterize this risk from picloram residues in compost and may demonstrate potential mitigations such as compost holding times. It is requested that a study protocol is submitted for review before the study is conducted. Through the SFIREG Pesticides Operations & Management committee on September 16, 2013, it was made known that Dow AgroSciences is developing a molecular imprinted polymer for solid phase extraction that could be used for detecting picloram in compost. It was expected that a method could be released to state laboratories by April 2014. A compost dissipation study would be instrumental in interpreting the monitoring data that will become available after this method is disseminated.

The following ecological data gaps exist for picloram:

- **Estuarine/Marine Invertebrate Chronic Toxicity Study (OCSPP Guideline 850.1350):** Picloram has outdoor uses that may result in exposure to estuarine/marine invertebrates. In the absence of data EPA will use an acute to chronic ratio (ACR) for the freshwater invertebrate and apply that to the lower bound of the acute estuarine/marine data to estimate a chronic endpoint for the estuarine/marine invertebrate. Although according to CFR 158 the lack of this study is considered a data gap, the utility of a new estuarine/marine invertebrate life cycle study for the risk assessment is considered low given the predicted difference between the exposure estimates from the RED and the toxicity estimate derived using the ACR approach in this document. Therefore, a new estuarine/marine invertebrate life cycle test is not requested.
- **Estuarine/Marine Fish Early-Life Stage Toxicity Study (OCSPP Guideline 850.1400):** An estuarine/marine fish early life-stage test using the TGAI has not been submitted, since it was not considered to be necessary based on previous risk assessments for picloram. In the absence of data EPA will use an ACR from the rainbow trout acute and chronic data with picloram acid and apply that to the acute estuarine/marine data point values to estimate a chronic endpoint for saltwater fish. Although according to CFR 158 the lack of this study is considered a data gap, the utility of a new estuarine/marine fish ELS study for the risk assessment is considered low at this time, given the predicted difference between the exposure estimates from the RED and the toxicity estimate derived using the ACR approach in this document. Therefore, a new saltwater early life stage toxicity test is not requested.
- **Algal Toxicity Study (OCSPP Guideline 850.4500).** No data is available for the estuarine/marine diatom for picloram acid or the TIPA or potassium salts. Since the freshwater diatom was the most sensitive taxa tested for the TIPA salt, a study on estuarine/marine diatoms is required for this ai. A new study is not required for the acid or potassium salt.

- **Acute Avian Oral Toxicity Study (OCSPP Guideline 850.2100):** No data is available for passerine species, which may be more sensitive than the tested mallard and bobwhite species. Although the $LD_{50}$ and $LC_{50}$ data for the mallard and bobwhite were all nondefinitive (“greater than”) values, there were sublethal effects in the acute oral mallard study with picloram acid and treatment related mortalities in the acute dietary bobwhite study with picloram potassium salt. Therefore, a passerine study is required using either the acid or the potassium salt. A protocol should be submitted to the Agency, prior to study initiation.
- **Chronic Avian Reproduction Study (OCSPP Guideline 850.2300):** No data is available for chronic effects to birds from picloram use. Therefore, a chronic study is required using either picloram acid or the potassium salt. Although the $LD_{50}$ and $LC_{50}$ data for the mallard and bobwhite were all nondefinitive (“greater than”) values, there were sublethal effects in the acute oral mallard study with picloram acid and treatment related mortalities in the acute dietary bobwhite study with picloram potassium salt. Since the dietary study exposure is more similar to a chronic exposure than the acute oral study exposure, it is recommended that the chronic study be conducted with the bobwhite.
- **Terrestrial Plant Seedling Emergence and Vegetative Vigor Tier II Studies (OCSPP Guidelines 850.4100 and 850.4150):** A previously submitted study (MRID 41296501) used to support the registration of the TIPA salt was downgraded to supplemental--qualitative. Therefore, no quantitatively acceptable data is available for picloram’s effect to terrestrial plants from the TIPA salt formulation. The most sensitive species (for dicots: tomato, drybean and soybean. For monocots: onion and wheat) as indicated in the currently available data should be tested with the TIPA salt formulation.
- **Data Gaps for products containing picloram combined with other herbicides**

  A number of end-use products contain picloram in combination with another herbicide (*i.e.* 2,4-D, dicamba, fluroxypyr and/or triclopyr). Since these products are labeled for aerial application, there exists the potential for spray drift to non-target plants. Therefore, these data are needed to conduct a risk assessment:

  - Terrestrial plant vegetative vigor (850.4150) and seedling emergence (850.4100) tests using the most sensitive dicot and monocot species: tomato, drybean, soybean, onion and wheat using TEP.

  The preceding studies with TEP are a subset of what is required to support the existing use pattern according to the 40 CFR Part 158 and were identified because they resulted in the most sensitive endpoints for picloram and terrestrial plants appeared to be more sensitive to a multi ai formulation containing picloram TIPA salt and 2,4-D TIPA salt than to either a.i. alone (using picloram K salt as a surrogate for the picloram TIPA salt and 2,4-D DMA salt as a surrogate for 2,4-D TIPA salt due to a lack of terrestrial plant data on formulations containing only one TIPA salt). For the preceding studies where EFED is requesting data on TEP, data are needed on a representative product that contains both picloram and the additional ai(s). When there are multiple products with dual active ingredients, as is the case for the picloram and 2,4-D a.i.’s, the representative TEP used is normally the product with the highest percentages of active ingredient and/or is expected to result in the highest toxicity.

Major uncertainties:

Major toxicological data gaps primarily affect the risk assessment for direct effects to aquatic and terrestrial plants, as these taxa were the main risk concerns previously identified for this chemical and quantitatively acceptable data is missing, especially for the picloram TIPA salt formulation's effects to terrestrial plants. Spray drift damage to non-target plants from picloram formulations is of particular concern for this chemical. In addition to the lack of information for effects of the picloram TIPA salt formulation (usually co-formulated with the 2,4-D TIPA salt), there is also a lack of toxicity information for formulations with multiple a.i.'s, especially where those formulations may be applied aerially. Multiple a.i. formulations other than those with 2,4-D that are applied aerially and have higher potential for spray drift damage to non-target organisms include those with picloram TIPA salt and dicamba (*e.g.* Trooper Extra, PD-2, Grazon PD2), picloram TIPA salt and fluroxypyr 1-methylheptyl ester (*e.g.* Trooper Pro, Surmount), picloram K salt and triclopyr (*e.g.* GF-1249). The absence of information on picloram TIPA salt's (as well as the multiple a.i.formulations') toxicity to plants prohibits quantitative assessment of the potential risk to nontarget plants posed by the application of these products.

A significant uncertainty regarding environmental fate is picloram's behavior in compost. Degradation and dissipation processes differ in compost as compared to guideline environmental fate studies. An improved environmental chemistry method and a compost dissipation study are needed to better characterize this pathway. The absence of information on the persistence of picloram residues in composted plant material or animal manure prohibits a quantitative assessment of the potential risk to nontarget taxa posed by the application of composted material containing these residues. Without information on the fate of picloram residues in these media, the risk assessment will only be able to qualitatively address risk to nontarget taxa where plants from treated areas or manure from animals fed on treated plants is used.

# 2. Introduction

Picloram is a systemic herbicide that acts as a plant growth regulator by mimicking naturally occurring plant growth hormones called auxins. Tomlin (2004) indicates that it has effects on broad-leaf plants, but not grasses, with the exception of some seedlings. Picloram disrupts normal plant growth by binding to molecules that are normally used as receptors by auxins. Because picloram is more persistent in plants than auxins, the binding causes abnormal growth and leads to plant death (Tu *et al.*, 2001). Picloram and other herbicides in the pyridine carboxylic acid chemical family (*e.g.,* clopyralid and aminopyralid) can act at multiple sites in a plant and disrupt hormone balance and protein synthesis, the metabolic pathways that affect plant growth. Picloram and other members of the pyridine carboxylic acid family are systemic and can move in both the xylem and the phloem to areas of new plant growth (meristematic tissues). Picloram uptake is primarily through the foliage, but root uptake is possible.

The use information presented in this problem formulation was obtained from the tables in the EFED Label Data Report dated 7/18/2013, from BEAD's Chemical Profile for Registration Review (USEPA, 2013), and from various evaluated labels. There are currently 9 Section 3 registered products for picloram acid, 15 Section 3 registered products for picloram triisopropanolamine salt, and 10 Section 3 registered products for picloram potassium salt. There are no Special Local Needs (SLN) registrations for picloram.

The following labeling statements appear on all picloram labels to avoid contamination of compost, aquatic environments and drinking water from use on agricultural products. Label language was determined to be necessary due to composting and irrigation water incidents.

ENVIRONMENTAL HAZARD STATEMENTS

> This pesticide is toxic to some plants at very low concentrations. Non-target plants may be adversely affected if pesticide is allowed to drift from areas of application. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Do not contaminate water used for irrigation or domestic purposes by cleaning of equipment or disposal of wastes or rinsate. Do not allow runoff or spray to contaminate wells, irrigation ditches or any body of water used for irrigation or domestic purposes. Do not make application when circumstances favor movement from treatment site.
>
> This chemical is known to leach through soil into groundwater under certain conditions as a result of agricultural use. Use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.
>
> This chemical can contaminate surface water through spray drift. Under some conditions, picloram may also have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several months post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow groundwater, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetative filterstrips, and areas over-laying tile drainage systems that drain to surface water.

# 3. Use Characterization

Picloram is a systemic herbicide used for control of woody plants and a wide range of broadleaf weeds in range management programs. It is registered for use on agricultural crop soils for the following: barley, fallow, oats, wheat, pastureland, and forestry. It is also registered for use on conservation reserve program land, non-agricultural sites, rights-of-way, industrial sites, storage yards, fencerows, industrial storage areas, and hedgerows. Picloram is formulated as emulsifiable, soluble concentrate, and as a solution-ready-to-use. Picloram can be applied by broadcast, spot treatment as foliar (leaf), bare soil spray, as a basal bark treatment, and/or by air as broadcast spray. The chemical profile produced by BEAD, located in the docket, lists the use patterns of maximum exposures for the current uses of picloram. The most dominant use is on pastureland representing 98% of usage between 1998 and 2011. From 2007-2011, the annual total agricultural usage averaged approximately 810,000 pounds acid equivalent (lbs a.e.) for 5.3 million acres. On average, the states with the most agricultural usage in terms of pounds a.e. applied are Texas (26%), Oklahoma (12%), and Arkansas (10%), and the top states in terms of the total area treated are Texas (31 %), same percentage for Oklahoma (12%), and Arkansas (9%). Usage information for non-agricultural uses is not reported. The absence of this information is a significant uncertainty especially considering the broad spectrum of non-agricultural uses.

Labels for use in forests, conifers, and rooftops do not specify maximum seasonal application rates or a maximum number of applications per year. A forest dissipation study indicates an exposed soil dissipation half-life of 34 days, therefore applications of picloram several times per year would not be unreasonable. Without clarification of the labels or details on usage in forests and conifers, conservative assumptions will be made. Conservative assumptions will also be made for number of roof top applications per year in the absence of usage information or clarification of the labels. All broadcast applied uses may be applied aerially.

The following tables summarize use patterns for picloram acid (PC code 005101; MW: 241.5 g/mol ), the TIPA-salt of picloram (PC code 005102; MW: 432.6 g/mol), and the K-salt of picloram (PC code 005104; MW: 280.6 g/mol). Though these are three distinct chemical moieties, they will be assessed together using the acid equivalence (a.e.) method. That is, only the picloram acid component will be assessed and the application rates of the TIPA-salt and the K-salt will be adjusted to account for only picloram acid. For instance the 1.939 lbs a.i./acre maximum application rate for the TIPA salt will be converted to 1.085 lbs a.e./acre because only 56% of the a.i. constitutes the a.e. in the case of the TIPA salt (241.5 $g*mol^{-1}$/432.6 $g*mol^{-1}$ = 56%).

**Table 1. Label use information for picloram acid (PC Code 005101)**

| Use Site | Formulation Type | Max Rate (lbs a.e./Acre) | | Max. No. of Apps per Year | Min. App. Interval | Application Methods | Comments |
|---|---|---|---|---|---|---|---|
| | | Single | Annual | | | | |
| AGRICULTURAL FALLOW/IDLELAND / CONSERVATION RESERVE | SC/L | 0.514 | 1.932 | NS | 30 days | Broadcast | Preplant/Postplant |
| CONIFERS (PLANTATIONS/NURSERIES) | SC/L | 1.932 | NS | NS | NS | Frill, Girdle, Stump, Broadcast, Band, High volume spray, Tree injection | |
| FOREST TREES (ALL OR UNSPECIFIED) | SC/L | 1.932 | NS | NS | 1 year | Frill, Girdle, Stump, Broadcast, Band, High volume spray, Tree injection | |
| NONAGRICULTURAL UNCULTIVATED AREAS/SOILS | SC/L | 1.932 | 1.932 | 1 | NS | Broadcast | |
| PASTURES | SC/L | 1.027 | 1.932 | NS | 30 day | Broadcast; high volume dilute spray | Preplant/Postplant |
| RANGELAND | SC/L | 1.027 | 1.932 | NS | 30 day | Broadcast; high volume dilute spray | Preplant/Postplant |

SC- Suspended Concentrate

L-Liquid
NS-Not Specified

**Table 2. Label use information for TIPA-salt of picloram (PC Code 005102)**

| Use Site | Formulation Type | Maximum Rate (lbs a.e./Acre) | | Max. No. of Apps/ Year | Min. App. Interval | Application Methods | Comments |
|---|---|---|---|---|---|---|---|
| | | Single | Annual | | | | |
| AGRICULTURAL FALLOW/IDLELAND / CONSERVATION RESERVE | EC/SC/L | 0.282 | 1.105 | NS | NS | Broadcast, Spot treatment, high volume spray | Preplant/Postplant |
| CONIFERS (PLANTATIONS/NURSERIES) | SC/L | 1.082 | NS | NS | NS | Band treatment | Thinning |
| FOREST TREES (ALL OR UNSPECIFIED) | RTU/SC/L | 1.082<br>2.064 lbs/100 gal | 1.133 | NS | 1 year | Frill, Girdle, Stump, Broadcast, High volume spray | |
| NONAGRICULTURAL UNCULTIVATED AREAS/SOILS | RTU/EC/SC/L | 1.938<br><br>2.064 lbs/100 gal | 1.133 | NS | 1 year | Frill, Girdle, Stump, Broadcast, High volume spray | Restricted from Nassau and Suffolk Counties, New York |
| PASTURES | SC/L/EC | 0.565<br><br>1.334 lb a.i./100 gallons | 1.105 | NS | 30 day | Broadcast; high volume dilute spray, spot treatment | Preplant/Postplant |
| RANGELAND | SC/L/EC | 0.565<br>1.334 lbs /100 gal | 1.105 | NS | 30 day | Broadcast; high volume dilute spray, spot treatment | Preplant/Postplant |
| ROOFS | EC | 0.665<br><br>2.23 lb / 100 gal | NS | NS | NS | Broadcast, high volume spray | Weed postemergence |

RTU – Ready to use
EC – Emulsifiable Concentrate
SC- Suspended Concentrate
L- Liquid
NS-Not Specified

**Table 3. Label use information for K-salt of picloram (PC Code 005104)**

| Use Site | Formulation Type | Max Rate (lbs a.e./Acre) | | Max. No. of Apps per Year | Min. App. Interval | Application Methods | Comments |
|---|---|---|---|---|---|---|---|
| | | Single | Annual | | | | |
| AGRICULTURAL FALLOW/IDLELAND / CONSERVATION RESERVE | EC/SC/L | 1.029 | NS | NS | 30 days | Spot treatment | |
| FOREST TREES (ALL OR UNSPECIFIED) | EC/SC/L | 1.029 | NS | NS | NS | Broadcast | |
| NONAGRICULTURAL UNCULTIVAT | EC/SC/L | 1.029 | 1.029 | NS | NS | Broadcast, Spot | Restricted from Nassau and Suffolk |

| Use Site | Formulation Type | Max Rate (lbs a.e./Acre) | | Max. No. of Apps per Year | Min. App. Interval | Application Methods | Comments |
|---|---|---|---|---|---|---|---|
| | | Single | Annual | | | | |
| ED AREAS/SOILS | | | | | | treatment, high volume spray | Counties, New York |
| PASTURES | EC/SC/L | 1.029 | 1.029 | NS | NS | Broadcast, Spot treatment, high volume spray | |
| RANGELAND | EC/SC/L | 1.029 | 1.029 | NS | NS | Broadcast, Spot treatment, high volume spray | |

RTU – Ready to use
EC – Emulsifiable Concentrate
SC- Suspended Concentrate
L- Liquid
NS-Not Specified

# 4. Conclusions from Previous Risk Assessments

## 4.1. Ecological Risk Assessment

The last ecological risk assessment conducted on picloram and its associated salts was the 1995 RED (USEPA, 1995). The RED raised concerns for picloram's risk of contamination of ground and surface water and damage to terrestrial nontarget plants adjacent to areas of application via runoff and drift and possibly from more distant areas where groundwater is used for irrigation water or discharged into surface water. 10 states had reported picloram detections in groundwater at the time of this risk assessment. Risks were not assessed quantitatively for nontarget organisms exposed via irrigation water.

In March 1985, the Agency issued a Registration Standard for picloram. This document required additional data and imposed a maximum level of hexachlorobenzene (HCB) in the technical product of 200 ppm. It also required testing for nitrosoamines. The sole registrant of picloram has complied with these requirements; no nitrosoamines were detected in picloram products (< 1 ppm) and the level of HCB, an impurity that results from the manufacturing process, has been certified to be less than 100 ppm. The picloram Final Reregistration Standard and Tolerance Reassessment (FRSTR) was issued 5/18/88.

Picloram and its two salts (as well as its ester, for which there currently are no active registrations) were considered to be similar to each other in their biological and chemical characteristics in the environment and were not distinguished in the fate review. The assessment noted the following data gaps for the TIPA and potassium salts: acute data for estuarine/marine fish, Tier 2 terrestrial seedling emergence and vegetative vigor for sensitive crops that had been reported in recent incident reports including for watermelon, tobacco, potato, pasture, tomato, bell pepper, and hay, Tier 2 aquatic plant toxicity studies and for the TIPA salt only, and a freshwater fish early life stage study. The requested Tier 2 terrestrial plant toxicity studies on sensitive crops reported in incident reports were not submitted.

For aquatic animals, the RED determined that the endangered species LOC was exceeded for freshwater fish when the potassium salt was applied without incorporation and for estuarine/marine invertebrates when the TIPA salt was applied aerially (**Table 4**). For terrestrial animals, the mammalian listed species LOC was exceeded for both the TIPA and potassium salts regardless of application method. The listed and non-listed terrestrial plant LOCs were exceeded for all application types and a.i.'s. The maximum EEC determined in the assessment was approximately 800 ppb for a ground application of picloram TIPA salt applied at 2.2 lbs ai/A without incorporation and with a shallow (6 inch deep) receiving body.

**Table 4. Exceedances of the LOC from Picloram RED**

| **Species** | **Risk** | |
|---|---|---|
| | Listed | Non-listed |
| Freshwater Fish[1] | Yes[3] | No |
| Freshwater Invertebrates | No | No |
| Estuarine/marine Fish[1] | Yes[3] | No |
| Estuarine/marine Inverts | **Yes**[4] | No |
| Aquatic Plants (vascular & nonvascular) | No | No |
| Mammals | **Yes** | No |
| Birds[2] | No | No |
| Terrestrial Invertebrates | No | No |
| Terrestrial Plants | **Yes** | **Yes** |

[1]Fish are considered surrogates for aquatic-phase amphibians
[2]Birds are considered surrogates for reptiles and terrestrial-phase amphibians
[3]Levels of concern were exceeded for endangered fish species for the potassium salt administered by ground application without incorporation only.
[4]Levels of concern were exceeded for endangered estuarine/marine invertebrates only for the TIPA salt applied aerially.

## *4.2. Drinking Water Exposure Assessments*

Characterization of drinking water exposure from surface water was addressed in the 1995 RED:

> "Picloram has high potential to contaminate surface water by runoff from use areas. Regardless of the original chemical form, substantial quantities of the anion will be available for runoff for several months following application, considering its persistence in the environment. As indicated leaching will be the major route of dissipation from soil. Picloram that leaches into ground water may contaminate surface water in places where ground water discharges into surface water."

Characterization of drinking water exposure from groundwater was also addressed in the 1995 RED:

> "Considering the widespread use of picloram and the detections in many states, the Agency is concerned about degradation of water quality in picloram use areas. Despite a

specialized use pattern, eventual contamination of ground water is virtually certain in areas where residues persist in the overlying soil. Once in ground water, the chemical is unlikely to degrade even over a period of several years."

A drinking water assessment will be needed for registration review that addresses picloram acid and the impurity, HCB.

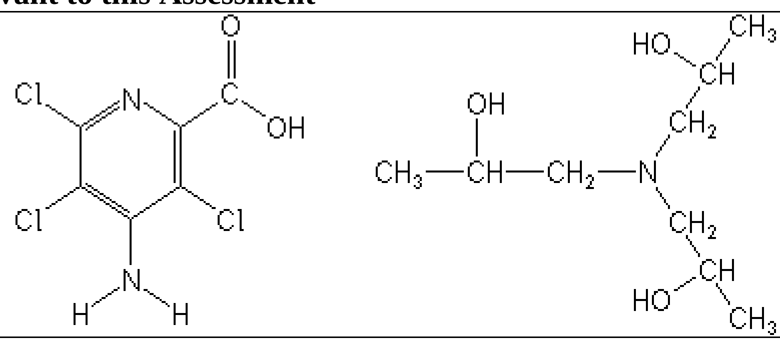
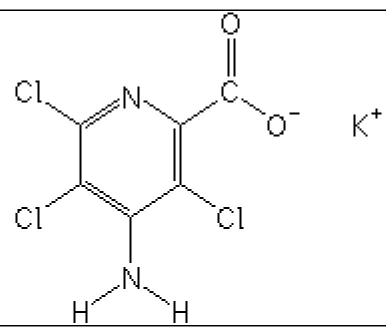
### *4.3. Clean Water Act Programs*

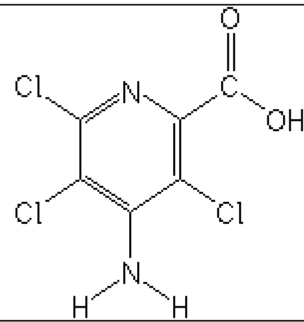
Picloram is not identified as a cause of impairment for any water bodies listed as impaired under section 303(d) of the Clean Water Act. No Total Maximum Daily Load (TMDL) criteria have been developed for picloram. Aquatic benchmarks have been established for picloram and are available at http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm. Any data submitted or otherwise located as part of the registration review process may be used to update aquatic life benchmarks if applicable.

## 5. Environmental Fate and Transport

Picloram acid and its salts, triisopropanolamine picloram (TIPA-salt) and potassium picloram (K-salt), are highly mobile and persistent in the environment in the form of the single chemical moiety, picloram. Picloram is prone to runoff and leaching with numerous monitoring detections in surface water and groundwater. The TIPA-salt and K-salt dissociate readily to picloram acid and the acid is present in its anionic form at environmental pH (pKa = 2.3).

**Table 5. Chemical Structures Relevant to this Assessment**

| | |
|---|---|
| TIPA-salt of picloram |  |
| K-salt of picloram |  |

| | |
|---|---|
| Picloram acid |  |

Picloram is highly hydrophilic and non-volatile with aqueous solubility of 430 ppm, Henry's law constant of $3.0 \times 10^{-12}$ atm-m$^3$/mol, and a log octanol-to-water partitioning coefficient of -1.92. Picloram acid is highly mobile with an estimated organic carbon adsorption coefficient of 7.2 L/kg$_{o.c.}$ and highly persistent to metabolism with aerobic soil metabolism half lives ranging from 167 days to 513 days in seven soils based on single first order kinetics. Current NAFTA degradation kinetics procedures will be used to estimate half-lives and subsequent input parameters in the registration review risk assessment. Picloram is stable to other forms of metabolism and hydrolysis. The only significant form of degradation for picloram is aqueous photolysis with a half-life of 16 days at pH 5. Major metabolites from aqueous photolysis include oxamic acid and 3-oxo-beta-alanine. Though not analyzed in terrestrial field dissipation studies, these degradates are not thought to persist in the environment as dissipation half-lives of the parent are significantly longer than the aqueous photolysis half-life of the parent (*i.e.*, the aqueous photolysis pathway is not significant in the environment). Terrestrial field dissipation half-lives average 140 days on bare ground and 211 days on grass with picloram consistently leaching to the deepest sampled horizons in each study (36 to 60 inches).

Chemicals in the pyridine carboxylic acid family such as picloram have been associated with incidents involving exposure and effects from compost and manure with undegraded residues. Due to the prevalence of use of picloram on materials commonly used for compost and animal feed and the highly persistent nature of the compound, compost and manure represent complete exposure pathways to terrestrial plants. Chemicals in this family, including picloram, have also been associated with incidents involving exposure and effects from irrigation water with undegraded residues (see Section 6.3). Due to the highly persistent nature of the compound in water, irrigation water using contaminated surface or ground water also represents a complete exposure pathway to terrestrial plants.

**Table 6. Chemical Properties and Environmental Fate Parameters of Picloram Acid**

| **Parameter** | **Value** | **Description** | **Source** |
|---|---|---|---|
| **Selected Physical/Chemical Parameters** | | | |
| Molecular mass (molecular formula) | 241.5 g/mol<br>432.6 g/mol<br>280.6 g/mol | Picloram acid<br>TIPA<br>K-salt | Picloram RED |
| Log dissociation constant (pKa) | 2.3 | Strong acid; Anionic form at environmental pH | Footprint[1]: Accessed 9/26/13 |

| Parameter | Value | Description | Source |
|---|---|---|---|
| Vapor pressure (25°C) | $6.3*10^{-7}$ torr | Non-volatile | MRID 45645503 |
| Aqueous solubility (25°C) | 430 ppm<br>218 ppm | Picloram acid<br>TIPA salt<br><br>Moderately soluble | Picloram RED<br>MRID 45787203 |
| Henry's Law Constant (25°C) | $3.0x10^{-12}$ atm-$m^3$/mol | Non-volatile | Footprint[1]:<br>Accessed 9/16/13 |
| Log octanol-to-water partition coefficient<br>(log $K_{OW}$) | -1.92 | Hydrophilic | Footprint[1]:<br>Accessed 9/16/13 |
| **Persistence** | | | |
| Hydrolysis half-life (20°C) | Stable | | Footprint[1]:<br>Accessed 9/16/13 |
| Aqueous photolysis half-life | 16 day | UV-filtered Xenon arc lamp used, 25°C, pH 5 | MRID 46027501 |
| Aerobic soil metabolism half-life (25°C) | 383 days (loamy sand)<br>513 days (sandy loam)<br>171 days (silt loam)<br>167 days (loam)<br>429 days (loam)<br>412 days (clay)<br>190 days (silt loam) | Single first order estimates<br><br>Input parameter = 402 days (USEPA, 2002a) | MRID 128976 |
| Anaerobic soil metabolism half-life (25°C) | Stable | | MRID128976 |
| Anaerobic aquatic metabolism half-life (25°C) | Stable | | MRID128976 |
| **Mobility** | | | |
| Freundlich soil-water partition coefficients ($K_F$); organic carbon-normalized Freundlich coefficients ($K_{FOC}$) | 0.14 L/kg;<br>7.2 $L/kg_{OC}$ | Highly Mobile | Footprint[1]:<br>Accessed 9/16/13 |
| **Field Dissipation** | | | |

| Parameter | Value | Description | Source |
|---|---|---|---|
| Terrestrial field dissipation half-life; field cover | California<br>278 days; bareground<br>135 days; grass plot<br>---<br>North Carolina<br>108 days; bareground<br>104 days; grass plot<br>---<br>Montana<br>256 days ± 37 days from 4 tests; grass and herbaceous groundcover<br>---<br>Texas<br>34 days; bareground | | MRID 42579002<br>---<br>MRID 42579001<br>---<br>MRID 42535302<br>MRID 42558302<br>---<br>MRID 40059801 |
| Forest dissipation half-life | Washington<br>123 days; bareground<br>34 days; unexposed soil | | MRID 42579003 |

[1] - http://sitem.herts.ac.uk/aeru/footprint/index2.htm

An aerobic aquatic metabolism study has not been submitted but it is not expected to impact risk conclusions in the registration review risk assessment given current aquatic toxicity data. PRZM/EXAMs was run assuming an aerobic aquatic metabolism of 100 days, 429 days, and stability (**Table 7**). The use scenario assumed was 1.9 kg a.i./ha with 1 application.

**Table 7. EECs Demonstrating Impact of Aerobic Aquatic Metabolism Data**

| Aerobic Aquatic Metabolism | 1 in 10 year peak, 21-day and 60-day EEC range in µg/L |
|---|---|
| Stable with $K_{OC}$ of 13 | 49-51 |
| Stable with $K_{OC}$ of 0 | 52-55 |
| 429 days $K_{OC}$ of 13 | 12-15 |
| 100 days $K_{OC}$ of 13 | 3-7 |

The low toxicity endpoints and LOCs to consider for water are acute 96-hr LC50 of 5.5 mg/L for fish (5500 µg/L x LOC 0.05 = 275 µg/L), 2.61 mg/L for plants (2610 µg/L x LOC 1 = 2610 µg/L), and a NOAEC for fish of 0.55mg/L (550 µg/L LOC=1). These results indicate that whether aerobic aquatic metabolism is considered stable or within the range that might be observed based on aerobic soil metabolism data, the risk assessment will not be affected given current data. The submission of more sensitive aquatic toxicity data may introduce an endpoint that would be impacted by aerobic aquatic metabolism data. However, the new data would need to be at least 5x more sensitive than any currently available data in order for risk conclusions to be impacted by aerobic aquatic metabolism data.

# 6. Receptors

**Tables 8** through **13** provide a summary of the aquatic and terrestrial taxonomic groups, and the most sensitive surrogate species tested to characterize the potential acute and chronic ecological effects of picloram and its associated salts. In addition, the tables provide a preliminary overview of the potential acute toxicity of picloram and its associated salts by providing the acute toxicity classifications. Toxicity endpoint values for the TIPA and K salts have been converted to picloram acid equivalents to facilitate comparison between the different forms and these values will be used in the risk assessment. Based on the available ecotoxicity information, picloram and its associated salts are slightly to moderately acutely toxic to estuarine/marine and freshwater fish and slightly toxic to practically non-toxic to freshwater and estuarine/marine invertebrates. For aquatic plants, the TIPA salt appears to be more toxic to vascular plants than to non-vascular plants, but for the potassium salt, the most sensitive aquatic plant taxa were freshwater diatoms. For terrestrial animals, the available data indicate that picloram and its associated salts are practically non-toxic to all taxa. As expected for an herbicide, picloram's end-use products appear particularly toxic to terrestrial plants. Additional detail is included in the following tables. No information is available on the toxicity of the major metabolites oxamic acid and 3-oxo-beta-alanine. However, as described above in Section 5, these degradates are not expected to persist in the environment.

## *6.1. Effects to Aquatic Organisms*

**Table 8. Summary of the Most Sensitive Endpoints from Aquatic Toxicity Studies for Picloram acid (PC Code 005101)**

| Taxonomic Group | Study Type | TGAI/ TEP %ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Freshwater fish[1] | Acute | TGAI 92.9% | Rainbow trout *Oncorhynchus mykiss* | 96-hr $LC_{50}$ = 5.5 mg ae/L (5.2—5.8) Nominal | Moderately toxic | MRID 00112016 |
| | Chronic (Early Life-Stage) | TGAI 93.8% | Rainbow trout *Oncorhynchus mykiss* | 60-D NOAEC = 0.55 mg a.i./L LOAEC = 0.88 mg ae./L Endpoint: Length & Weight | N/A | MRID 00151784 |
| Freshwater invertebrates | Acute | TGAI 90% | Water Flea (*Daphnia magna*) | 48-hr $EC_{50}$ = 34.4 mg ae/L (31.0—37.8) Nominal | Slightly toxic | MRID 00141979 |

| Taxonomic Group | Study Type | TGAI/ TEP %ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| | Chronic | TGAI 90% | Water Flea (*Daphnia magna*) | 21-D NOAEC = 11.8 mg ae/L<br>LOAEC = 18.1 mg ae/L<br>Endpoint: Mean brood size/adult & total young/adult<br>Mean-Measured | N/A | MRID 00151783 |
| Estuarine/marine fish | Acute | -- | No Data | No Data | N/A | -- |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Estuarine/marine invertebrates | Acute | -- | No Data | No Data | N/A | -- |
| | Chronic | -- | No Data | No Data | N/A | -- |
| | Acute | -- | No Data | No Data | N/A | -- |
| Aquatic plants and algae | Vascular | -- | No Data | No Data | N/A | -- |
| | Non-vascular | TGAI 93.4% | Green Algae *Pseudokirchneriella subcapitata* | 96-Hr $EC_{50}$ = 34.9 mg ae/L (33.1—36.9)<br>NOAEC = 18 mg ae/L<br>Nominal | N/A | MRID 00155937 |

[1] Freshwater fish are surrogates for aquatic-phase amphibians.

**Table 9. Summary of the Most Sensitive Endpoints from Aquatic Toxicity Studies for Picloram TIPA salt (PC Code 005102)**

| Taxonomic Group | Study Type | TGAI/TEP % Picloram ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Freshwater fish[1] | Acute | -- | No Data | No Data | N/A | -- |
| | Chronic (Early Life-Stage) | TEP 5.9% ae | Fathead minnow *Pimephales promelas* | 32-D NOAEC = 4.02 mg ae/L<br>LOAEC = 6.65 mg ae/L<br>Mean-measured<br>Endpoint: Survival | N/A | MRID 43959504 |

| Taxonomic Group | Study Type | TGAI/TEP % Picloram ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Freshwater invertebrates | Acute | -- | No Data | No Data | N/A | -- |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Estuarine/marine fish | Acute | TEP 5.4% ae | Inland silverside *Menidia beryllina* | 96-hr $LC_{50}$ = 31.6 mg ae/L (19.89—33.07) | Slightly toxic | MRID 43959503 |
| | Chronic | -- | No Data | 60-D NOAEC = 3.16 mg ae/L | N/A | ACR[2] |
| Estuarine/marine invertebrates | Acute | TEP 10.3% | Eastern oyster *Crassostrea virgninica* | 5.59 < 48-hr $EC_{50}$ < 10.06 mg ae/L Nominal | Moderately toxic | MRID 00129074 |
| | Acute | TEP 10.3% | Pink shrimp *Penaeus duorarum* | 96-hr $EC_{50}$ = 171mg ae/L | Practically non-toxic | MRID 00129074 |
| | Chronic | -- | Eastern Oyster *Crassostrea virgninica* | 21-D NOAEC = 1.90 mg ae/L | N/A | ACR[3] |
| Aquatic plants and algae | Non-vascular | TEP 10.2% | Green Algae *Pseudokirchneriella subcapitata* | 120-Hr $EC_{50}$ = 130 mg ae/L (100—170.4)<br>120-Hr NOAEC = 10.3 mg ae/L<br>Mean-measured | N/A | MRID 41407701 |
| | Non-vascular | TEP 10.2% | Freshwater diatom *Navicula pelliculosa* | 120-Hr $EC_{50}$ = 223 mg ae/L (179—279)<br>NOAEC = 145 mg ae/L | N/A | MRID 43230303 |
| | Non-vascular | TEP 5.4% ae | Blue-green algae *Anabaena flos-aquae* | 120-Hr $EC_{50}$ = 352 mg ae/L (315—404)<br>NOAEC = 31mg ae/L | N/A | MRID 43230309 |
| | Vascular | TEP 5.4% ae | Duckweed *Lemna gibba* | 14-D $EC_{50}$ = 2.61 mg ae/L (1.45—4.70)<br>NOAEC = 0.13 mg ae/L | N/A | MRID 43230312 |

[1] Freshwater fish are considered a surrogate for aquatic-phase amphibians

[2] For estuarine/marine fish, an ACR of 10 was derived from the picloram acid acute and chronic freshwater fish data and applied to the acute picloram TIPA salt estuarine/marine fish endpoint to generate a chronic NOAEC value.

[3] For estuarine/marine invertebrates, an ACR of 2.92 was derived from the picloram acid acute and chronic daphnid data and applied to the lower bound of the picloram TIPA salt eastern oyster acute endpoint to generate a chronic NOAEC value.

**Table 10. Summary of the Most Sensitive Endpoints from Aquatic Toxicity Studies for Picloram K salt (PC Code 005104)**

| Taxonomic Group | Study Type | TGAI/ TEP %ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Freshwater fish[1] | Acute | TEP 24.4% | Rainbow Trout *Oncorhynchus mykiss* | 96-Hr $LC_{50}$ = 22.4 mg ae/L Nominal | Slightly Toxic | MRID 00129072 |
| | Chronic (Early Life-Stage) | -- | No Data | No Data | N/A | -- |
| Freshwater invertebrates | Acute | TGAI 88.6% | Water flea *Daphnia magna* | 48-hr $EC_{50}$ > 86 mg ae/L | Practically non-toxic | MRID 00129077 |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Estuarine/marine fish | Acute | TEP 24.1% (20.8% ae) | Sheepshead minnow *Cyprinodon variegates* | 96-hr $LC_{50}$ > 113 mg ae/L Mean-measured | Practically non-toxic | MRID 43959502 |
| | Chronic | -- | No Data | 60-D NOAEC > 11.3 ppm | N/A | ACR[2] |
| Estuarine/marine invertebrates | Acute | TEP 24.9% | Eastern oyster *Crassostrea virgninica* | 15 < 48-hr $EC_{50}$ < 28 mg ae/L Nominal | Slightly toxic | MRID 00129073 |
| | Acute | TEP 24.9 | Pink shrimp *Penaeus duorarum* | 96-hr $EC_{50}$ = 108 mg ae/L (98—119) | Practically non-toxic | MRID 00129073 |
| | Chronic | -- | Eastern oyster *Crassostrea virgninica* | 21-D NOAEC = 5.3 mg ae/L | N/A | ACR[3] |
| Aquatic plants and algae | Non-vascular | TEP 35.2% | Green Algae *Pseudokirchneriella subcapitata* | 120-Hr $EC_{50}$ = 56 mg ae/L (41—77)<br>120-Hr NOAEC = 11.3 mg ae/L<br>Mean-measured | N/A | MRID 41407702 |
| | Non-vascular | TEP 27.9% (24.1% ae) | Freshwater diatom *Navicula pelliculosa* | 120-Hr $EC_{50}$ = 3.2 mg ae/L (2.7—3.7)<br>120-Hr NOAEC < 0.84 mg ae/L<br>Mean-measured | N/A | MRID 43230302 |
| | Non-vascular | TEP 27.9% (24.1% ae) | Blue-green algae *Anabaena flos-aquae* | 120-Hr $EC_{50}$ = 504 mg ae/L (462—558)<br>120-Hr NOAEC = 336 mg ae/L<br>Mean-measured | N/A | MRID 43230308 |

| Taxonomic Group | Study Type | TGAI/ TEP %ai | Surrogate Species | Toxicity Value (95% Confidence Interval) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| | Vascular | TEP 27.9% (24.1% ae) | Duckweed *Lemna gibba* | 14-D $EC_{50}$ = 82.3 mg ae/L (65--107) 14-D NOAEC = 43.5 mg ae/L Measured (0-hr) | N/A | MRID 43230311 |

[1] Freshwater fish are considered surrogates for aquatic-phase amphibians.
[2] For estuarine/marine fish, an ACR of 10.0 was derived from the picloram acid acute and chronic freshwater fish data and applied to the picloram potassium salt estuarine/marine nondefinitive acute endpoint to generate a chronic NOAEC value.
[3] For estuarine/marine invertebrates, an ACR of 2.92 was derived from the picloram acid acute and chronic daphnid data and applied to the lower bound of the picloram potassium salt eastern oyster acute endpoint to generate a chronic NOAEC value.

Based on the above toxicity data, the acid and potassium salt have similar acute toxicity to freshwater fish while picloram acid is approximately an order of magnitude more toxic to freshwater fish on a chronic basis than the TIPA salt. A study with coho salmon (MRID 45205107) using the potassium salt had a slightly more sensitive $LC_{50}$ of 15.1 mg ae/L compared to the rainbow trout study, but was considered qualitatively supplemental since the exposure was only for 24 hours. No acute freshwater fish data is available for the TIPA salt and no chronic freshwater fish data is available for the potassium salt. The two salts have a similar low acute toxicity to estuarine/marine fish. The lack of chronic saltwater fish data for the acid or either salt is considered a data gap, however an ACR from picloram acid's acute and chronic rainbow trout endpoints can be applied to the saltwater acute fish data for both salts and results in NOAECs that are higher than the maximum EECs predicted from the RED. Additionally, the acute data indicate that freshwater fish are more sensitive than saltwater fish. Therefore, the weight of evidence indicates it is unlikely that additional data would add significant value to the risk assessment.

Picloram acid and the potassium salt both exhibited low acute toxicity to freshwater invertebrates, with no data available for the TIPA salt. The only chronic data available for picloram's effects to freshwater invertebrates is for the acid which showed a reduction in reproduction (mean brood size/adult and total young/adult) at 18.1 mg ae/L. Although no data was available for picloram acid's effects to estuarine/marine invertebrates, the TIPA and potassium salts had similar acute toxicity to both the eastern oyster and pink shrimp. In the absence of additional data, an ACR from picloram acid's acute and chronic daphnid endpoints will be applied to the lower bound of the most sensitive acute estuarine/marine invertebrate endpoints to derive a chronic endpoint for estuarine/marine invertebrates for both the TIPA and potassium salts. This approach yields NOAECs that are higher than the maximum EECs predicted from the RED. Therefore, it is unlikely that additional data would add significant value to the risk assessment.

For aquatic plants, green algae was more sensitive to picloram acid compared to the two salts. Vascular plants were approximately two orders of magnitude more sensitive than non-vascular plants to the TIPA salt while for the potassium salt the freshwater diatom was 1-2 orders of magnitude more sensitive than other aquatic plant taxa. Data are missing for effects of either the acid or salts to marine diatoms. This is considered a major data gap for the TIPA salt, since the freshwater diatom was much more sensitive than the other aquatic plant taxa to this salt, but data are not required for either the acid or the potassium salt.

## 6.2. *Effects to Terrestrial Organisms*

**Table 11. Summary of the Most Sensitive Endpoints from Terrestrial Toxicity Studies for Picloram acid (PC Code 005101)**

| Taxonomic Group | Study Type | TGAI/TEP %ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Birds[1] | Acute | 93.8% | Mallard Duck (*Anas platyrhynchos*) | $LD_{50}$ > 2510 mg/kg-bw | Practically non-toxic | MRID 00157173 |
| | Acute oral | -- | No Data | No Data | N/A | -- |
| | Sub-acute dietary | -- | No Data | No Data | N/A | -- |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Mammals | Acute Oral | TGAI 94.1% | Laboratory rat (*Rattus norvegicus*) | $LD_{50}$ = 4,012 mg/kg (females) | Practically non-toxic | MRID 40479413 |
| | Acute Inhalation | TGAI 94.1% | Laboratory rat (*Rattus norvegicus*) | 4-Hr $LC_{50}$ > 0.035 mg/L | I | MRID 40479415 |
| | Subchronic Feeding | TGAI 92% | Laboratory rat (*Rattus norvegicus*) | 13-Wk NOEL: 50 mg/kg/d LOEL: 150 mg/kg/day Endpoints: liver weight increases and changes in the liver | N/A | MRID 00110537 |

| Taxonomic Group | Study Type | TGAI/TEP %ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| | Chronic (2-Generation Reproduction) | TGAI 94.1% | Laboratory rat (*Rattus norvegicus*) | NOAEL = 200 mg/kg/day LOAEL = 1000 mg/kg/day Endpoints: lesions in kidneys, blood in urine, decreased urine specific gravity, increased kidney weights | N/A | MRID 40834301 |
| Terrestrial Invertebrates | Acute contact | TEP % ai unknown | Honey bee (*Apis mellifera L.*) | 48-hr $LD_{50}$ > 14.5 µg/bee | Practically non-toxic | MRID 00036935 |
| Terrestrial plants[2] | Seedling Emergence | -- | Monocot – No Data | No Data | N/A | -- |
| | | -- | Dicot – No Data | No Data | N/A | -- |
| | Vegetative Vigor | -- | Monocot – No Data | No Data | N/A | -- |
| | | -- | Dicot – tomato | No Data | N/A | -- |

[1] Birds are considered a surrogate for terrestrial phase amphibians and reptiles

**Table 12. Summary of the Most Sensitive Endpoints from Terrestrial Toxicity Studies for Picloram TIPA salt (PC Code 005102)**

| Taxonomic Group | Study Type | TGAI/TEP %Picloram ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Birds[1] | Acute oral | -- | No Data | No Data | N/A | -- |
| | Acute oral | -- | No Data | No Data | N/A | -- |

| Taxonomic Group | Study Type | TGAI/TEP %Picloram ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| | Sub-acute dietary | TEP 10.2% | Mallard duck *(Anas platyrhynchos)* & Bobwhite quail (*Colinus virginianus)* | 8-D $LC_{50}$ > 5600 mg ae/kg/d | Practically non-toxic | MRIDs 00129069 00129071 |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Mammals | Acute Oral | TEP 33.9% ae | Laboratory rat (*Rattus norvegicus*) | 14-D $LD_{50}$ > 2,800 mg ae/kg | Practically non-toxic | MRID 41381201 |
| | Acute Inhalation | TEP 33.9% ae | Laboratory rat (*Rattus norvegicus*) | 4-Hr $LC_{50}$ > 0.04 mg ae/L | II | MRID 41381203 |
| | Sub-chronic Feeding | TEP 34% ae | Laboratory rat (*Rattus norvegicus*) | 13- Wk NOAEL = 50 mg ae/kg/d LOAEL = 300 mg ae/kg/day Endpoints: increased liver weights, hepatocellular hypertrophy and increased kidney weights in males only | N/A | MRID 41442701 |
| Terrestrial Invertebrates | Acute contact | TEP 5.68% ae | Honey bee (*Apis mellifera L.*) | 48-hr $LD_{50}$ > 56 µg ae/bee | Practically non-toxic | 41366901 |
| Terrestrial plants[2] | Seedling Emergence | -- | Monocot – No Data | No Data | N/A | -- |
| | | -- | Dicot – No Data | No Data | N/A | -- |
| | Vegetative Vigor | -- | Monocot – No Data | No Data | N/A | -- |
| | | -- | Dicot – tomato | No Data | N/A | -- |

[1] Birds are considered a surrogate for terrestrial phase amphibians and reptiles

**Table 13. Summary of the Most Sensitive Endpoints from Terrestrial Toxicity Studies for Picloram K salt (PC Code 005104)**

| Taxonomic Group | Study Type | TGAI/TEP %ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| Birds[1] | Acute oral | -- | No Data | No Data | N/A | -- |
| | Acute oral | -- | No Data | No Data | N/A | -- |
| | Sub-acute dietary | TEP 24.4% ae 11.6% ae | Mallard duck *(Anas platyrhynchos)* & Bobwhite quail (*Colinus virginianus)* | 8-D $LC_{50}$ > 8,600 mg ae/kg | Practically non-toxic | MRIDs 00129068 00112978 |
| | Chronic | -- | No Data | No Data | N/A | -- |
| Mammals | Acute Oral | TEP 38.8% | Laboratory rat (*Rattus norvegicus*) | 14-D $LD_{50}$ = 3048 mg ae/kg (females) | Practically non-toxic | 40479401 |
| | Acute Inhalation | TEP 38.8% | Laboratory rat (*Rattus norvegicus*) | 4-Hr $LC_{50}$ > 1.41 mg ae/L | -- | 40479403 |
| Terrestrial Invertebrates | Acute contact | TEP 30.4% ae | Honey bee (*Apis mellifera L.*) | 48-hr $LD_{50}$ > 86 µg ae/bee | Practically non-toxic | 41366902 |
| Terrestrial plants[2] | Seedling Emergence | TEP 24.1% | Monocot – Wheat *Triticum aestivum* | $EC_{25}$ = 0.082 lbs ae/A (0.053—0.13) NOAEC = 0.027 lbs ae/A | N/A | MRID 43959505 |
| | | TEP 24.1% | Dicot – Tomato *(Solanum lycopersicum)* | $EC_{25}$ = 0.0066 lbs ae/A (0.0047—0.095) NOAEC = 0.0034 lbs ae/A | N/A | MRID 43959505 |

| Taxonomic Group | Study Type | TGAI/TEP %ai | Surrogate Species | Toxicity Value (all units in terms of measured active ingredient) | Acute Toxicity Classification | Source |
|---|---|---|---|---|---|---|
| | Vegetative Vigor | TEP 25.2% | Monocot – Wheat (*Triticum sestivum)* | $EC_{25}$ = 0.028 lbs ae/A $EC_{05}$ = 0.0035 lbs ae/A | N/A | MRID 44156701 |
| | | TEP 25.2% | Dicot – Tomato *(Solanum lycopersicum*) | $EC_{25}$ = 0.00016 lbs ae/A NOAEC = 0.000026 lbs ae/A | N/A | MRID 44156701 |

[1] Birds are considered a surrogate for terrestrial phase amphibians and reptiles.

Picloram acid is considered practically non-toxic to birds on an acute oral basis. Though no acute oral data is available for the salts, both salts are practically non-toxic on an acute dietary basis. There is no data for the effects of picloram acid or its salts to passerine birds. Passerine bird species can frequently be more sensitive than upland and waterfowl bird species. Since sublethal effects including loss of coordination, lower limb weakness and lethargy occurred at the lowest treatment level (398 mg a.i./kg) in the acute oral study (MRID 00157173) with picloram acid and treatment related mortalities occurred in the bobwhite dietary study (MRID 00129068) with the potassium salt, the lack of a subacute oral passerine study is considered a major data gap. No acceptable chronic data for birds was available for picloram acid or either salt. This is also considered a major data gap.

Picloram acid and both salts are considered practically non-toxic to mammals on an acute oral basis. Acute inhalation studies with the rat resulted in non-definitive (>) endpoints for the acid and both salts. On a subchronic basis, picloram acid had similar toxicity to rats as the TIPA salt. On a chronic basis, exposure to picloram acid resulted in increased incidence of microscopic lesions in male (and some female) kidneys, blood in urine, decreased urine specific gravity, and increased absolute & relative kidney weights at 1000 mg a.i./kg.

Picloram acid and both salts were also practically non-toxic on an acute contact basis to the honey bee.

Quantitatively acceptable data on the effects of picloram to terrestrial plants was only available for the potassium salt. Although a previous seedling emergence and vegetative vigor study was considered supplemental and had been used to support the registration of the TIPA salt (MRID 41296501), this study does not provide quantitatively acceptable data since a NOAEC could not be achieved for several species, height data was not collected and only three replicates were used which prohibits the accurate extrapolation of an $EC_{05}$. The study may only be utilized qualitatively to characterize risk. The lack of quantitatively acceptable terrestrial plant data with the TIPA salt is a major data gap.

A number of end-use products contain picloram in combination with another herbicide (*i.e.* 2,4-D, dicamba, fluroxypyr and/or triclopyr). Since these products are labeled for aerial application, there exists the potential for spray drift to non-target plants. Therefore, these data are needed to conduct a risk assessment:

- Terrestrial plant vegetative vigor (850.4150) and seedling emergence (850.4100) tests using the most sensitive dicot and monocot species: tomato, drybean, soybean, onion and wheat using TEP.

For the preceding studies where we are requesting data on TEP, data are needed on a representative product that contains both picloram and the additional ai(s). When there are multiple products with dual active ingredients, as is the case for the picloram and 2,4-D a.i.'s, the representative TEP used is normally the product with the highest percentages of active ingredient and/or is expected to result in the highest toxicity.

EFED conducted an analysis comparing the toxicity of formulations containing either picloram K salt or 2,4-D TIPA salt with multi-ai data from formulations containing both picloram TIPA salt and 2,4-D TIPA salt in order to see if the combination of multiple herbicides had enhanced toxicity **(Appendix B).** For taxa where data was available on these three formulations (including aquatic plants, aquatic invertebrates and fish), there was no evidence of enhanced toxicity from the picloram and 2,4-D TIPA salts mixture. However, no data was available for the effect of formulations solely containing one active ingredient of2,4-D TIPA salt on terrestrial plants. In this case, EFED used 2,4-D DMA salt as a comparison, which was identified as the most toxic 2,4-D salt to dicots in the 2013 2,4-D Problem Formulation (USEPA, 2013). The most sensitive terrestrial plant species for which data was available for both picloram salts and 2,4-D DMA salt was the tomato. Since no quantitatively acceptable information was available for the picloram TIPA salt formulation (co-formulated with 2,4-D TIPA salt), the analysis was conducted using a qualitatively acceptable study (MRID 41296501). The tomato was an order of magnitude more sensitive to the picloram/2-4 D TIPA salts formulation than to the picloram K salt formulation and 4 orders of magnitude more sensitive than to the 2,4-D DMA salt formulation. This indicates that there is potential for additive or synergistic effects from formulations containing picloram and an additional herbicide.

## *6.3. Ecological Incidents*

A review on August 28, 2013 of the Ecological Incident Information System (EIIS, version 2.1.1), which is maintained by the Agency's Office of Pesticide Programs, indicates a total of 56 reported ecological incidents in the United States associated with the use of the picloram acid and salt active ingredients (summarized by certainty in **Table 14** with a more thorough listing by date and location in **Appendix C**). 51 of the reported incidents associated with picloram involved damage to terrestrial plants and appear to be crop damage. At least 10 of these terrestrial plant incidents were due to exposure of nontarget plants from spray drift. Five of the reported incidents associated with picloram involved fish kills. The certainty categories[1] regarding the likelihood that the use of picloram caused the 56 incidents ranged from Unlikely (1 incident, 2%), Possible (26 incidents, 46%), Probable (26 incidents, 46%) and Highly Probable (3 incidents, 5%).

At least 42 of the reported incidents (75.0%) have occurred since the time of the RED (1995). 11 (20%) of the incident reports did not have information regarding the date of occurrence, therefore it is unclear in those cases whether they occurred before the time of the RED or are more recent. Three reported incidents may have involved the use of irrigation water and an additional three more were reported showing residues in compost as the potential cause of the incident. A more thorough discussion of the aquatic incidents, irrigation water incidents and composting incidents is provided below.

**Table 14. Summary of ecological incidents associated with picloram use, by certainty**

| Incident Type | Use Type | Certainty | | | | |
|---|---|---|---|---|---|---|
| | | All (excluding unlikely) | Unlikely | Possible | Probable | Highly Probable |
| Aquatic | (Misuse) | 2 | | 2 | | |
| | (Registered Use) | 2 | | | 1 | 1 |
| | (Unknown) | 1 | | 1 | | |
| Plants | Agricultural Site (Misuse) | 11 | | 6 | 4 | 1 |
| | Agricultural Site (Registered Use) | 28 | 1 | 10 | 17 | |
| | Agricultural Site (Unknown) | 12 | | 7 | 4 | 1 |
| Total | | 56 | 1 | 26 | 26 | 3 |

*Aquatic Incidents*

In 1989, in Montana (I000046-001), thousands of trout at a fish hatchery were killed after Tordon (containing picloram potassium salt) was sprayed by a road crew ¼ mile upstream from the hatchery, followed by heavy rain. Residues of picloram in vegetation near the road found 0.12 ppm picloram. The certainty of injury being attributed to the fish in this incident as a result of picloram use was categorized as probable and the legality was considered a registered use of picloram.

[1] The Ecological Incident Information System (EIIS) used by EPA to store incident data relies on the following certainty indices:

- **Highly Probable**: (residues detected in affected organisms and other lines of evidence support cause)
- **Probable:** (residues were not measured or the measured residues were not sufficient to be considered toxic, but pesticide was used in close proximity and would be capable of exerting such an effect)
- **Possible**: multiple pesticides were used in close proximity and any of them are capable of causing such an effect.
- **Unlikely:** there are no measured residues and the observed effects are not consistent with those caused by pesticides used in the area or there was no pesticide use known in the area.
- **Unrelated:** effects observed in the incident are unrelated to pesticide use.

In 1994 (Incident I001616-001; location not reported), trees were treated with Access Herbicide (containing picloram) near a pond. One fish (species not reported) was found dead in the pond. No residue information was provided, but the incident was considered of high probability and the legality was considered a registered use.

Incident I003325-001 (location and date not reported) was a report indicating that Tordon 22K (containing picloram potassium salt) was used as a surface/spot treatment with a roadside sprayer and two days later there was a fish kill in an adjacent pond consisting of two dead brown trout and 103 dead rainbow trout. The certainty that picloram caused this incident was considered possible and the legality of the use was considered an accidental misuse.

In 1997, in Oklahoma (I006139-001), it was reported that there was a fish kill of an unknown number of four fish species (bass, catfish, crappie and perch) after an application of a pesticide containing picloram and 2,4-D and following run-off from a heavy rain into a half acre pond. The grass around the pond was also affected and reported to be dying. The certainty that picloram caused this incident was considered possible and the legality was not determined.

In 1998, in Texas (I007873-001), 300 fish were reported to have died three to four weeks after Tordon had been sprayed on weeds near a pond and following a heavy rain. The species of fish was not reported. The certainty that picloram caused this incident was considered possible and the legality of the use was considered an accidental misuse.

As several of these incidents do not describe the timing between pesticide application and resulting fish kill, it is possible that some of these incidents were a result of plant damage leading to decay and subsequent lower dissolved oxygen concentrations in water, though this may be unlikely for Incident I003325-001, where fish died so shortly (2 days) after pesticide application.

*Irrigation Water Incidents*

Incident I001458-001 (location and date not reported) was a report indicating that Tordon 22K (containing picloram potassium salt) was applied on weeds near a well. The well water was subsequently used to irrigate 90 acres of potatoes, which were injured. The certainty of injury being attributed to the non-target plants in this incident as a result of picloram use was categorized as probable and the legality of the use was not determined.

In 1998, in Virginia (I008451-001) tobacco plants were reportedly injured after irrigation from a pond. The landowner reported that an application of picloram to a transmission right-of-way had been made in 1974 and caused a large degree of non-target plant injury and death (primarily tuliptrees). The landowner built a pond in the drainage leading from the right-of-way in 1984. When he irrigated his tobacco from that pond, the tobacco was stunted or killed. In 1998, the landowner irrigated from a pond uphill from the original pond which had tested clear at the time of the 1984 planting. However, this pond was pumped low and towards the end of the season the landowner’s tobacco plants were injured following application of irrigation water. Residues in the pond and spring water showed picloram to be present in concentrations from 1—3.71 ppb. The certainty of injury being attributed to the non-target plants in this incident as a result of picloram use was categorized as probable and the original use was considered a registered use of picloram.

Incident I004352-001 was reported in Oklahoma (date of incident not reported) where Tordon 101 was applied to a railroad right-of-way, but accidentally to a section where picloram entered a water source used to irrigate five acres of greenhouses growing a variety of potted plants including 50,000 poinsettas which were all damaged. Samples of the water used for irrigation indicated picloram in concentrations from 3—28 ppb. The certainty of injury being attributed to the non-target plants as a result of picloram use was categorized as highly probable. The legality of the use was considered an accidental misuse.

*Composting Incidents*

In 2000, in Washington (I010624-001), home gardeners reported non-target plant injuries associated with the distribution of compost by Washington State University. Tordon 101 Mixture containing picloram TIPA salt and 2,4-D was used on University fields and the resulting harvested hay was fed to cattle. Manure from the cattle contained picloram residues and residues were also detected in soil samples from home gardens where the compost was applied. It was considered unlikely that damage to the non-target plants could be attributed to the 2,4-D use, but the certainty of injury being attributed to the non-target plants as a result of picloram use was considered probable. The legality of the use was considered a registered use.

In 2007, in Texas (I018930-031), an incident was reported where Grazon (picloram TIPA salt and 2,4-D) allegedly caused injury to 2 acres of cantelope, watermelon, onion, tomatoes and peppers to the point where these crops could not produce fruits. Manure from horses fed hay previously treated with Grazon was composted and used for fertilizer in an organic production system. The manure was composted, applied to the field and incorporated with tillage equipment. The incident report cites that label directions were not followed in this case. However, there was apparently no way for the organic grower to know that Grazon had been used on the hay that was fed to the horses prior to the grower obtaining manure and composting. The certainty of injury being attributed to the non-target plants as a result of picloram use was considered possible. The legality of the use was considered an accidental misuse.

In 2007, in Virginia (I018677-001), an incident was reported where mulch containing picloram residues was applied to a field and resulted in damage to 10 acres of crops (tomato, potato and squash). Plant samples showed detections of the herbicide. The certainty of injury being attributed to the non-target plants as a result of picloram use was considered highly probable. The legality of the use was not determined.

# 7. Exposure Pathways of Concern

The environmental fate properties and use patterns of picloram indicate that direct spray onto food residues, spray drift, leaching to ground water, and runoff represent potential transport mechanisms of picloram to aquatic and terrestrial organisms. Due to picloram's persistence, picloram may be transported in the environment in compost (either from composted vegetation or manure). Finally, picloram may be present in surface water or groundwater used as irrigation water.

Drinking water and inhalation exposure pathways were screened using the SIP (Screening Imbibition Program) and STIR (Screening Tool for Inhalation Risk) screening methods. Drinking water was found to be a potential exposure pathway of concern (LOC exccedances are expected) on an acute basis for birds, but not mammals. SIP and STIR are described in detail at: http://www.epa.gov/oppefed1/models/terrestrial/index.htm.

The Screening Tool for Inhalation Risk (STIR v.1.0) was used to assess the potential for risk to birds and mammals through inhalation exposure. The exposure pathways that are assessed by this tool include both droplet inhalation and vapor-phase inhalation. STIR, used in the problem formulation phase, is intended to determine if exposure is likely and not whether the potential for risk exists. If STIR predicts that exposure is likely, additional inhalation data may be necessary to adequately assess risk due to the inhalation exposure pathway. Based on STIR analysis, inhalation is not considered likely to be a significant route of exposure for birds and mammals (see **Appendix D** for STIR inputs and outputs). It should be noted that the mammalian inhalation $LC_{50}$s for picloram acid and both salts were all non-definitive (>) values.

The Screening Imbibition Program (SIP 1.0, Released June 15, 2010) was used to calculate an upper bound estimate of exposure using picloram's solubility in water (430 mg/L), the most sensitive acute and chronic avian toxicity endpoints (mallard acute $LD_{50}$ of 2510, no chronic NOAEC available) and the most sensitive acute and chronic mammalian toxicity endpoints (female Laboratory Rat acute $LD_{50}$ of 3536 for picloram potassium salt and Rat chronic NOAEL of 200 mg/kg-bw). Drinking water exposure alone was not determined to be a potential pathway of concern for mammalian species on either an acute or chronic basis. Although drinking water exposure alone does not appear to be of concern, this does not take into account that when aggregated with other exposure pathways (dietary food sources, dermal, inhalation) drinking water may contribute to a total exposure that has a potential for effects on non-target animals and should be explored further. Because there is a high degree of conservatism in the SIP 1.0 exposure estimate, there is limited expectation that use scenarios not triggering a SIP 1.0 concern would contribute significantly to aggregate risks from water plus diet when a refined water exposure model is incorporated in the actual quantitative risk assessment. Detailed information about SIP v1.0, as well as the tool, can be found on the EPA's website at http:www.epa.gov/pesticides/science/models_pg.htm#terrestrial.

However, drinking water exposure alone was determined to be a potential pathway of concern for avian species on an acute basis and data was insufficient to evaluate whether drinking water exposure is a potential pathway of concern for avian species on a chronic basis. This pathway will be explored further with the development of SIP v.2.0 in the Ecological Risk Assessment for Picloram. The chronic avian data expected to be requested in the DCI will also be used in this assessment of drinking water exposure. For a sample of the output generated by SIP v.1.0, please see **Appendix D**.

Consistent with what has been noted in the RED, residues of picloram in surface or ground water and their use for irrigation could result in potential injury to nontarget plants because of the compound's persistence. Analysis of the incident data supports the possibility that irrigation water is a viable exposure pathway. This pathway will be explored further in the Ecological Risk Assessment for Picloram by calculating the amount of irrigated water needed to exceed the available terrestrial plant endpoints on an acre of land using the expected environmental concentrations in surface and ground water.

Analysis of the incident data also support the possibility that compost, whether through application of composted plant materials containing picloram residues or manure from horses or cows fed such plant material, may also be a viable exposure pathway and could result in potential injury to nontarget plants because of the compound's persistence.

Exposure to aquatic organisms is likely to occur, and may affect both fish and invertebrates. Exposure may occur via ingestion or uptake through the gills and/or integument. Aquatic plants are also expected to be exposed via direct contact or vascular uptake.

# 8. Analysis Plan

## *8.1. Stressors of Concern*

### 8.1.1. Ecological Risk Assessment

Due to the persistence of picloram, the stressor of concern is the parent compound only as acid equivalents across the three picloram moieties. Although no data is available for the environmental degradation of the two salts to picloram acid, it is expected that they will readily be converted to picloram acid.

### 8.1.2. Drinking Water

The drinking water assessments conducted to support the registration review human health risk assessments of picloram will address the parent compound only as acid equivalents across the three picloram moieties in surface and ground waters. Picloram is likely to be found in groundwater and surface water due to its persistence and high mobility. The formulation impurity, HCB, will be assessed separately in a screening level approach.

## 8.2. Measures of Exposure

EFED will use standard available models to evaluate potential exposures to aquatic and terrestrial organisms as described at http://www.epa.gov/pesticides/science/models_db.htm.

### *Available Monitoring Data*

There are 39 detections of picloram in groundwater in 19 states ranging from 0.2 ppb to 3.9 ppb (NAWQA). The peak groundwater detection was in Shelby County, Tennessee. STORET reports 195 detections in surface water in 11 states ranging from 0.1 ppb to 24 ppb with 5 detections between 10 ppb and 20 ppb. The peak detection was in Doniphan County, Kansas. NAWQA reports additional surface water monitoring data with 87 detections in 26 states ranging from 0.1 ppb to 2.7 ppb.

### *Aquatic Exposure Modeling*

The models used to predict aquatic estimated environmental concentrations (EECs) are the Pesticide Root Zone Model coupled with the Exposure Analysis Modeling System (PRZM/EXAMS) and PRZM-Groundwater (PRZM-GW) publically available at: http://www.epa.gov/oppefed1/models/water/index.htm. The PRZM/EXAMS Standard Pond scenario will be used to estimate the aquatic EECs in surface water. Modeling will be conducted across the three picloram moieties in equal terms using the acid equivalent approach. All use patterns will be assessed using standard approaches, however, applications to rooftops is a non-standard use. Applications to rooftops will be assessed with the same method as spot treatments. That is, it is assumed residues are washed off by a minimum of 2 mm of water for washoff stipulated in the PRZM model. The treated area will be assumed to be 50% and impervious surface scenarios will be used.

### *Terrestrial Exposure Modeling*

Chemicals in the pyridine carboxylic acid family such as picloram have been associated with incidents involving exposure and effects from compost with undegraded residues. EFED does not currently model pesticide concentrations in compost as guideline metabolism data do not address the conditions in compost. EFED will investigate this issue in the ecological risk assessment.

Exposure estimates for terrestrial animals assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.5.2, March 2012). This model incorporates the Kenaga nomograph, as modified by Fletcher *et al*. (1994), which is based on a large set of field residue data. The upper limit values from the nomograph represent the 95$^{th}$ percentile of residue values from actual field measurements (Hoerger and Kenega 1972). The Fletcher *et al*. (1994) modifications to the Kenaga nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. A default 35-day foliar dissipation rate will be used because no foliar dissipation data have been submitted. Screening level calculations have suggested that the drinking water exposure pathway may be a significant concern for birds and will be further evaluated at the time of risk assessment with SIP v2.0.

EECs for terrestrial plants inhabiting dry and wetland areas are derived using TerrPlant (version 1.2.2, December 2006). This model uses estimates of pesticides in runoff and in spray drift to calculate EECs. EECs are based upon solubility, application rate and minimum incorporation depth in addition to type of formulation and method of application.The Agency is currently developing a replacement model for TerrPlant. If the replacement has been approved prior to the initiation of the risk assessment, this new model will be used instead.

Two spray drift models, AgDisp and AgDRIFT, are used to assess exposures of aquatic and terrestrial organisms to picloram deposited in terrestrial and aquatic habitats by spray drift. AgDrift (version 2.1.1; dated 12/29/2011) is the model most commonly used to simulate spray drift into terrestrial and aquatic environments from aerial and ground applications. AgDisp (version 8.13; dated 12/14/2004) (Teske and Curbishley, 2003) is used when a parameter needs to be modeled that is not available in AgDRIFT. Spray drift analysis will be an important part of the analysis in defining the potential area of effects for endangered species.

EFED does not currently have a standardized methodology for determining risk to non-target plants from applications of irrigation water sourced from surface or ground water that has been contaminated by a pesticide. However, EFED anticipates that an irrigation water analysis will be conducted at the time of the risk assessment using exposure values generated from currently available aquatic exposure models such as PRZM/EXAMS for surface water or PRZM-GW for groundwater exposures. This approach will be used to determine a depth (in inches) of irrigation water on a one-acre field necessary to cause an LOC exceedance to terrestrial plants and compared with representative cultural practices to characterize the potential risk associated with this exposure scenario.

These models are parameterized using relevant reviewed environmental fate data from registrant submissions and the literature; model input values will be consistent with the most recent version of EFED's aquatic model input parameter guidance (Version 2.1; EFED 2009).

*Applications Directly to Trees*

Applications to individual trees can result in absorption and translocation of aminopyralid from the site of application throughout the tree. Birds, mammals, and terrestrial invertebrates may be exposed through ingestion of leaves, seeds, pollen, or other edible portions of the tree. Leaves containing aminopyralid may fall onto the ground or into water resulting in movement of aminopyralid to soil and water. Finally, trees treated with aminopyralid may be used as compost. There is no currently approved model for estimating potential exposure to organisms from tree injection, cut-stump treatment, hack and squirt method, and frill and girdle methods. A screening-level estimate of exposure will be completed for this assessment. The method used to estimate exposure is discussed in a recently completed assessment in EFED, and the screen is based on the following assumptions (Bosecker and White, 2010, D383620; Hurley and Spatz, 2010, D381025):

(1) Aquatic Risk Assessment
    a. The total mass of chemical applied to the trees on one acre is assumed to enter a 20,000,000 L water body directly; EEC = total mass of chemical applied to trees on one acre/ 20,000,000 L.

    b. The maximum application rate is assumed to be 0.11 lbs a.e./A/year; EEC = those estimated in GENEEC for broadcast uses.

(2) Concentration of chemical in leaves
    a. Leaf concentration was estimated by assuming that 100% of the chemical was translocated to the leaves. Leaf mass is estimated using allometric equations developed for blue oak trees presented by the USDA Forest Service (Karlick and McKay, 2002). EEC = total mass of chemical applied / leaf mass on tree.

### 8.3. Measures of Effect

Toxicity data presented in Section 6 of this problem formulation will be used to calculate risk quotients. Any additional information submitted by the registrant or found in the open literature prior to conduct of the risk assessment will also be considered. The open literature studies are identified using EPA's ECOTOXicology database (ECOTOX) (USEPA, 2009), which employs a literature search engine for locating chemical toxicity data for aquatic life, terrestrial plants, and wildlife. The evaluation of both sources of data can also provide insight into the direct and indirect effects of pesticides on biotic communities from loss of species that are sensitive to the chemicals and from changes in structure and functional characteristics of the affected communities.

## 9. Endangered Species Assessments

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency will evaluate risks to federally listed threatened and/or endangered (listed) species from registered uses of pesticides in registration review. The process for evaluating potential risks to listed species is further described at http://www.epa.gov/oppfead1/endanger/litstatus/riskasses.htm. An endangered species assessment has not been conducted for picloram to date.

## 10. Endocrine Disruptor Screening Program

As required by FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of the Preliminary Problem Formulation for Registration Review (DP Barcode 416059), EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), picloram is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect. Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. On June 14, 2013, EPA published the Revised Second List of Chemicals for Tier I Screening in a Federal Register Notice. This revised second list included test orders/data call-ins for an additional 109 chemicals, which contained 41 pesticide active ingredients.

Picloram is among the group of 41 pesticide active ingredients on the revised second list of chemicals to be screened under the EDSP. The Agency will review the EDSP Tier 1 data and any "other scientifically relevant information" submitted in response to test orders. Based on this review the Agency will determine the need for additional testing. For further information on the status of the EDSP, the policies and procedures, the initial list of 67 chemicals or the overview of the second list of 109 chemicals, the test guidelines and the Tier 1 screening battery, please visit our website: http://www.epa.gov/endo/.

# 11. Preliminary Identification of Data Gaps

## 11.1. Environmental Fate

**Table 15** through **Table 17** identify environmental fate studies by MRID that offer data for each guideline requirement, as well as study classifications and whether or not further data are needed in order to support risk assessment.

**Table 15. Submitted Environmental Fate Data for Picloram Acid (PC code 005101)**

| OCSPP Guideline | Data Requirement | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Comments, Justification and Assumptions EPA will Make in Absence of Data |
|---|---|---|---|---|---|
| 835.2120 | Hydrolysis | --- | --- | No | Other aquatic studies indicate that picloram is stable to hydrolysis |
| 835.2240 | Aqueous photolysis | 46027501 | Supplemental | No | |
| 835.2410 | Soil photolysis | 157175 | Supplemental | No | |
| 835.4100 | Aerobic Soil Metabolism | 128976 | Acceptable | No | |
| 835.4200 | Anaerobic soil metabolism | 128976 | Acceptable | No | |
| 835.4300 | Aerobic aquatic metabolism | --- | --- | No | Persistence is demonstrated in aerobic soil metabolism and terrestrial field dissipation studies. If the registrant considers aerobic aquatic metabolism to be a significant route of metabolism, a study demonstrating such would be welcomed. However, a preliminary analysis was performed on page 16 of this document indicating that a study would likely not impact risk conclusions |
| 835.4400 | Anaerobic aquatic metabolism | --- | --- | No | Persistence is demonstrated in aerobic soil metabolism and terrestrial field dissipation studies. If the registrant considers anaerobic aquatic metabolism to be a significant route of metabolism, a study demonstrating such would be welcomed. |

| OCSPP Guideline | Data Requirement | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Comments, Justification and Assumptions EPA will Make in Absence of Data |
|---|---|---|---|---|---|
| 835.1230<br>835.1240 | Adsorption/ desorption and leaching | 111422 | Supplemental | Yes | MRID 111422 did not have sufficient number of acceptable soils and radiochemical purity was not reported in MRD 141646. Accurate quantification of sorption coefficients is highly important for a compound with high expected mobility. Current reported estimates are derived from Footprint[1]. |
| | | 141646 | Supplemental | | |
| 835.6100 | Terrestrial field dissipation | 42579001 | Acceptable | No | |
| | | 42579002 | Acceptable | | |
| | | 42535302<br>42558302 | Acceptable | | |
| 835.6300 | Forest field dissipation | 41395301 | Acceptable | No | |
| | | 42579003 | Acceptable | | |
| 850.1730 | Fish BCF | 42121108 | Acceptable | | |
| 850.6100 | Water and Soil Environmental Chemistry Methods | 45366<br>69078 | --- | Yes | Pending review, the data gap remains for methods on soil and water |
| | Compost Environmental Chemistry Methods | --- | --- | Yes | Methods that can be used with equipment found in state labs and use standards that can be readily obtained are requested. |
| 850.6100 | Soil Independent Laboratory Validation | --- | --- | Yes | |
| | Water Independent Laboratory Validation | --- | --- | Yes | |
| | Compost Independent Laboratory Validation | --- | --- | Yes | |
| Non-Guideline | Dissipation of Residues in Compost Study | -- | -- | Yes | The study will be used to characterize the risk from picloram residues in compost and may demonstrate potential mitigations such as compost holding times. It is requested that a study protocol is submitted for review before the study is conducted. In the absence of data, EPA will assume that picloram does not degrade in compost. |

1 - http://sitem.herts.ac.uk/aeru/footprint/index2.htm

**Table 16. Submitted Environmental Fate Data for TIPA-salt of Picloram (PC code 005102)**

| OCSPP Guideline | Data Requirement | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Justification and Assumptions EPA will Make in Absence of Data |
|---|---|---|---|---|---|
| 835.6100 | Terrestrial field dissipation | 00160126<br>40059801 | Supplemental | **No** | |

**Table 17. Submitted Environmental Fate Data for K-salt of Picloram (PC code 005104)**

| OCSPP Guideline | Data Requirement | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Justification and Assumptions EPA will Make in Absence of Data |
|---|---|---|---|---|---|
| 835.6100 | Forest field dissipation | 140317 | Supplemental | No | |
| 835.7100 | Prospective Groundwater | 42535302 | Supplemental | Yes | Less than 1/500$^{th}$ of an inch of irrigation water would be required to reach the vegetative vigor tomato NOAEC of 0.00016 lb a.e./ac based on Tier I PRZM-GW EECs. Furthermore, less than one inch of irrigation water would be required to reach 9 out of 10 reported terrestrial plant endpoints. A prospective groundwater study performed in an area representative of typical picloram use conditions would allow for better characterization of expected groundwater concentrations. Without a prospective groundwater study, only PRZM-GW can be relied upon to assess the exposure route. |

## *11.2. Effects*

**Table** 2**18** and **Table** 3 **19** identify ecological effects studies by MRID that offer data for each guideline requirement, as well as study classifications and whether or not further data are needed in order to support risk assessment. **Table 20** identifies the ecological effects studies requested for TEPs containing multiple active ingredients formulated with picloram.

**Table 2. Submitted Aquatic Ecological Effects Data for Picloram**

| OCSPP Guideline | Data Requirement | PC Code | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Current Additional Data Need |
|---|---|---|---|---|---|---|
| 850.1010 | Freshwater invertebrate acute toxicity | 005101 | 00141979 | Acceptable | No | -- |
| | | 005102 | None | N/A | No | |
| | | 005104 | 00129077 | Supplemental | No | |
| 850.1025 850.1035 850.1045 850.1055 | Saltwater invertebrate acute toxicity | 005101 | None | N/A | | |
| | | 005102 | 00129074 | Supplemental | No | |
| | | 005102 | 00129074 | Supplemental | No | |
| | | 005104 | 00129073 | Supplemental | No | |
| | | 005104 | 00129073 | Supplemental | No | |
| 850.1075 | Freshwater fish acute toxicity | 005101 | 00112016 | Acceptable | No | -- |
| | | 005102 | No Data | N/A | | |
| | | 005104 | 45205107 | Supplemental--Qualitative | | |
| | | 005104 | 00129072 | Supplemental | | |
| 850.1075 | Saltwater fish acute toxicity | 005101 | No Data | N/A | No | -- |
| | | 005102 | 43959503 | Acceptable | No | |
| | | 005104 | 43959502 | Acceptable | No | |
| 850.1300 | Freshwater invertebrate life cycle | 005101 | 00151783 | Acceptable | No | -- |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | No | |
| 850.1350 | Saltwater invertebrates life cycle | 005101 | None | N/A | No | In the absence of data EPA will use an acute to chronic ratio (ACR) to estimate a chronic endpoint for the saltwater invertebrate. |
| | | 005102 | None | N/A | No | |
| | | 005104 | None | N/A | No | |
| 850.1400 | Freshwater fish early-life stage | 005101 | 00151784 | Acceptable | No | -- |
| | | 005102 | 43959504 | Acceptable | No | |
| | | 005104 | No Data | N/A | No | |
| 850.1400 | Saltwater fish early-life stage | 005101 | No Data | N/A | No | In the absence of data EPA will use an acute to chronic ratio (ACR) to estimate a chronic endpoint for the saltwater invertebrate. |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | No | |
| 850.1500 | Fish life cycle | 005101 | No Data | N/A | No | -- |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | No | |
| 850.4400 | Aquatic plant | 005101 | No Data | N/A | No | -- |

| OCSPP Guideline | Data Requirement | PC Code | Submitted Studies (MRID) | Study Classifications | Are data needed to conduct risk assessment? | Current Additional Data Need |
|---|---|---|---|---|---|---|
| | Toxicity Test using Lemna spp. | 005102 | 43230312 | Acceptable | No | |
| | | 005104 | 43230311 | Acceptable | No | |
| 850.4500 | Algal toxicity | 005101 | 00155937 | Supplemental | No | No data is available for the estuarine/marine diatom for the TIPA or potassium salts. Since the freshwater diatom was the most sensitive taxa tested for the TIPA salt, a study on estuarine/marine diatoms is required. A new study is not required for the potassium salt |
| | | 005102 | 41407701 | Acceptable | No | |
| | | 005102 | 43230303 | Acceptable | No | |
| | | 005102 | No Data | N/A | **Yes** | |
| | | 005104 | 41407702 | Acceptable | No | |
| | | 005104 | 43230302 | Acceptable | No | |
| | | 005104 | No Data | N/A | No | |
| 850.4550 | Cyanobacteria | 005102 | 43230309 | Acceptable | No | -- |
| | | 005104 | 43230308 | Acceptable | No | |

**Table 3. Submitted Terrestrial Ecological Effects Data for Picloram**

| OCSPP Guideline | Data Requirement | PC Code | Submitted Studies (MRID) | Study Classifications | Are data needed for risk assessment? | Current Additional Data Need |
|---|---|---|---|---|---|---|
| 850.2100 | Avian oral toxicity | 005101 | 00157173 | Acceptable | **Yes** | A passerine acute oral study is required due to sublethal effects in the acute oral study and treatment related mortalities in the dietary studies with the potassium salt. |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | **Yes** | |
| 850.2200 | Avian dietary toxicity | 005101 | No Data | N/A | No | -- |
| | | 005102 | 00129069 | Supplemental | No | |
| | | 005102 | 00129071 | Supplemental | No | |
| | | 005104 | 00129068 | Supplemental | No | |
| | | 005104 | 00112978 | Supplemental | No | |
| 850.2300 | Avian reproduction | 005101 | None | N/A | **Yes** | An acceptable avian reproduction study using the bobwhite quail with either picloram acid or the potassium salt is required. |
| | | 005102 | None | N/A | **Yes** | |
| | | 005104 | None | N/A | **Yes** | |
| 850.3020 | Honey bee acute contact toxicity | 005101 | 00036935 | Supplemental | No | -- |
| | | 005102 | 41366901 | Acceptable | No | |
| | | 005104 | 41366902 | Acceptable | No | |

| OCSPP Guideline | Data Requirement | PC Code | Submitted Studies (MRID) | Study Classifications | Are data needed for risk assessment? | Current Additional Data Need |
|---|---|---|---|---|---|---|
| 850.3030 | Honey bee residue on foliage | 005101 | No Data | N/A | No | -- |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | No | |
| 850.3040 | Field testing for pollinators | 005101 | No Data | N/A | No | -- |
| | | 005102 | No Data | N/A | No | |
| | | 005104 | No Data | N/A | No | |
| 850.4100 | Seedling Emergence and Seedling Growth | 005101 | No Data | N/A | No | New Tier 2 data using the TIPA salt on tomato, drybean, soybean, onion and wheat is required. (see the Executive Summary) |
| | | 005102 | 41296501 | Supplemental—Qualitative | **Yes** | |
| | | 005104 | 43959505 | Acceptable | No | |
| 850.4150 | Vegetative Vigor | 005101 | No Data | N/A | No | New Tier 2 data using the TIPA salt on tomato, drybean, soybean, onion and wheat is required. (see the Executive Summary) |
| | | 005102 | 41296501 | Supplemental—Qualitative | **Yes** | |
| | | 005104 | 44156701 | Acceptable | No | |

**Table 20: Summary of Additional Data Requirements for Representative Technical End Use Products Containing Multiple Active Ingredients**

| OCSPP Guideline | Data Requirement |
|---|---|
| 850.4150 | Terrestrial Plant Vegetative Vigor using Tomato, Drybean, Soybean, Onion and Wheat |
| 850.4100 | Terrestrial Plant Seedling Emergence using Tomato, Drybean, Soybean, Onion and Wheat |

**Guideline Number: 835.7100**
**Study Titles: Prospective Groundwater Study**

Rationale for Requiring the Data

Five separate incidents have been reported on crop damage due to picloram contaminated drinking water. The veracity of these incidents is confirmed by comparing a screening level groundwater concentration of 0.421 mg a.e./L to the most sensitive terrestrial plant endpoint (vegetative vigor tomato NOAEC = 0.00016 lb a.e./ac) . Less than 1/500$^{th}$ of an inch of irrigation water would be required to reach this endpoint. Furthermore, less than one inch of irrigation water would be required to reach 9 out of 10 reported terrestrial plant endpoints. A prospective groundwater study performed in an area representative of typical picloram use conditions would allow for better characterization of expected groundwater concentrations.

Practical Utility of the Data

How will the data be used? The data will be used to advise on necessary depth to groundwater, well setback distances and/or other limitations on the use of groundwater for irrigation in picloram use areas in conjunction groundwater modeling estimates from PRZM-GW.

How could the data impact the Agency's future decision-making? The data will be used as the

| |
|---|
| most substantial piece in a weight-of-evidence approach to characterize the vulnerability of groundwater to picloram contamination and to develop mitigation options for the protection of irrigation water. |

| **Guideline Number: N/A**<br>**Study Titles: Dissipation study in compost** |
|---|
| **Rationale for Requiring the Data** |
| The application of picloram to vegetative matter that is subsequently used as compost or animal feed has been found to retain picloram residues and affect non-target plants. This route of exposure is common across the picolinc acid herbicides (aminopyralid, clopyralid, and picloram). A study is requested to demonstrate the rates of degradation and leaching in vegetative and manure composts. |
| **Practical Utility of the Data** |
| **How will the data be used?** Through the SFIREG Pesticides Operations & Management committee on September 16, 2013, it was made known that Dow AgroSciences is developing a molecular imprinted polymer for solid phase extraction that could be used for detecting picloram in compost. It was expected that a method could be released to state laboratories by April 2014. A compost dissipation study would be instrumental in interpreting the monitoring data that will become available after this method is disseminated.<br><br>**How could the data impact the Agency's future decision-making?** The study will be used to characterize this risk from picloram residues in compost and may demonstrate potential mitigations such as compost holding times. |

# 12. References

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## Appendix A- OPPIN Bibliography

005101 Picloram Eco Effects Bibliography

71-1 Avian Single Dose Oral Toxicity

| MRID | Citation Reference |
|---|---|
| 41144 | Stevenson, G.T.; Lapham, K. (1967) A Gamebird Toxicology Study of 4-Amino-3,5,6-trichloropicolinic acid, Triethylamine salt and Isoctyl ester in Bobwhite Quail. (Unpublished study received on unknown date under 8F0660; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094930-F) |
| 111457 | Stevenson, G.; Lapham, K. (1967) A Gamebird Toxicology Study of ... ?Tordon\|, Triethylamine Salt and Isooctyl Ester in Bobwite Quail. (Unpublished study received Jun 28, 1979 under 0F0863; submitted by Dow Chemical Co., Indianapolis, IN; CDL:098349-H) |
| 157173 | Beavers, J. (1983) An Acute Oral Toxicity Study in the Mallard with Picloram Technical: Final Report: Project No. 103-221. Unpub- lished study prepared by Wildlife International Ltd. 15 p. |

71-2 Avian Dietary Toxicity

| MRID | Citation Reference |
|---|---|
| 41113 or 75781 or | Stevenson, G.T. (1965) A Gamebird Toxicology Study--Acute Dietary Feeding of Tordon to Wild Type Mallard Ducklings. (Unpublished study received Nov 6, 1967 |

| | |
|---|---|
| 80912 multiple submission | under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094525-X) or ACC 91155 or ACC 91153<br>Stevenson, G.T. (1965) A Gamebird Toxicology Study--Acute Dietary Feeding of Tordon^(R)I to Wild Type Mallard Ducklings. (Unpub- lished study received Nov 21, 1967 under 8F0660; submitted by Dow Chemical Co., Indianapolis, Ind.; |
| 41471 | Stevenson, G.T. (1965) A Game Bird Toxicology Study--Acute Dietary Feeding of Tordon^(R)I in Bobwhite Quail. (Unpublished study received Nov 6, 1967 under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094524-D) |
| 41472 or 75780 | Stevenson, G.T. (1965) A Game Bird Toxicology Range Finding Study of Tordon in Wild Type Mallard Ducklings. (Unpublished study received Nov 6, 1967 under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094524-E) or 91155-G |
| 41473 | Stevenson, G.T. (1965) A Gamebird Toxicology Study--Acute Dietary Feeding of Tordon^(R)I to Wild Type Mallard Ducklings: Summary. (Unpublished study received Nov 6, 1967 under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094524-F) |
| 95165 | Stevenson, G.T. (1965) A Game Bird Toxicology Range Finding Study of Tordon, Daxtron and Dursban in Wild Type Mallard Ducklings: GH-A-107. (Unpublished study received Jun 10, 1969 under 9G0817; submitted by Dow Chemical Co., Indianapolis, Ind.; CDL:091411-N) |
| 111510 | Kenaga, E. (1974) Letter sent to M. Adamczyk dated Aug 16, 1974 ?Weedone 2,4,5-TP\|. (Unpublished study received Oct 9, 1974 under 264-61; submitted by Dow Chemical U.S.A., Midland, MI; CDL:120636-A) |
| 22923 | Hill, E.F.; Heath, R.G.; Spann, J.W.; et al. (1975) Lethal Dietary Toxicities of Environmental Pollutants to Birds: Special Scientific Report--Wildlife No. 191. (U.S. Dept. of the Interior, Fish and Wildlife Service, Patuxent Wildlife Research Center; unpublished report) |

71-4 Avian Reproduction

| MRID | Citation Reference |
|---|---|
| 41470 | Stevenson, G.T. (1965) Multiple Generation Reproductive Study of Tordon Fed Japanese Quail. (Unpublished study received Nov 6, 1967 under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094524-C) |
| 41909 | Stevenson, G.T. (1965) A Summary of Japanese Quail Reproduction Studies with Tordon^RI. (Unpublished study received Nov 6, 1967 under 0F0863; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094524-B) |
| 69974 | Stevenson, G.T. (19??) A Reproduction Study of Tordon--Picolinic Acid: 4-Amino-3,5,6-trichloro-, in Japanese Quail: Experiment No. 3-804-10. (Unpublished study received Nov 1, 1964 under unknown admin. no.; submitted by Dow Chemical U.S.A., Midland, Mich.; |

CDL:130992-K)

| | |
|---|---|
| 48033005 | Albers, P.; Hoffman, D. (1984) Evaluation of Potential Embryotoxicity and Teratogenicity of 42 Herbicides, Insecticides, and Petroleum Contaminants to Mallard Eggs. Archives of Environmental Contamination and Toxicology 13: 15-27. |
| 141980 | Somers, J.; Moran, E.; Reinhart, B. (1978) Reproductive success of hens and cockerels originating from eggs sprayed with 2,4-D, 2, 4-5-T and picloram followed by early performance of their proge- ny after a comparable in ovo exposure. Bull. Environm. Contam. Toxicol. 20:111-119. |

72-1 Acute Toxicity to Freshwater Fish

| MRID | Citation Reference |
|---|---|
| 68507 | Hughes, J.S.; Davis, J.T. (1964?) Effects of Selected Herbicides on Bluegill Sunfish. (Louisiana, Wild Life and Fisheries Commis- sion; unpublished study; CDL:231131-A) |
| 102855 | Silvo, O. (1967) Alustavia Tutkimuksia Eraiden Herbisidien Myrkyllisyydesta Nuorille Karpin Poikasille (Cyprinus catpio L.). Helsinki, Fin.: ?s.n.\|. (Suomen Kalatalous 32; also In unpublished submission received Feb 3, 1976 under 960-163; sub- mitted by Balcom Chemicals, Inc., Greeley, CO; CDL:228944-V) |
| 111458 | Bond, C.; Wilson, D.; Malick, J. (1967) Progress Report on Aquatic Weed Research (Project 773). (Unpublished study received Jun 28, 1979 under 0F0863; prepared by Oregon State Univ., Agricul- tural Experiment Station, Dept. of Fisheries and Wildlife, sub- mitted by Dow Chemical Co., Indianapolis, IN; CDL:098349-I) |
| 112016 | Batchelder, T. (1974) Acute Fish Toxicity of Picloram--(Dry Tordon Acid). (Unpublished study received Sep 10, 1976 under 464-541; submitted by Dow Chemical U.S.A., Midland, MI; CDL:226137-C) |
| 112971 | Hughes, J.; Davis, J. (1963) Variations in toxicity to bluegill sunfish of phenoxy herbicides. Weeds 11(1):50-53. (Also In unpublished submission received Jun 28, 1979 under 0F0863; sub- mitted by Dow Chemical Co., Indianapolis, IN; CDL:098349-O) |
| 129076 | Mayes, M.; Dill, D. (1982) The Toxicity of Picloram ... to Repre- sentative Freshwater Organisms: ES-561. (Unpublished study re- ceived Jun 24, 1983 under 464-502; submitted by Dow Chemical U.S.A., Midland, MI; CDL:250605-O) |
| 129078 | McCarty, W.; Alexander, H.; Park, C. (1977) Comparative Toxicity of Three Samples of Technical Picloram Containing Various Amounts of N"-(3,4,5,6-Tetrachloro-2-pyridinyl) Guanidine to Bluegill. (Unpublished study received Jun 24, 1983 under 464-502; submit- ted by Dow Chemical U.S.A., Midland, MI; CDL:250605-Q) |
| 129080 | Sergeant, M.; Blazek, D.; Elder, J.; et al. (1971) The toxicity of 2,4-D and picloram herbicides to fish. Proc. Indiana Academy of Science 80:114-123. (Also In unpublished submission received Jun 24, 1983 under 464-502; submitted by Dow |

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| 129086 | Woodward, D. (1976) Toxicity of the herbicides dinoseb and picloram to cutthroat (Salmo clarki) and lake trout (Salvelinus namay- cush). Journal of the Fisheries Research Board of Canada 33(8): 1671-1676. (Also In unpublished submission received Jun 24, 1983 under 464-502; submitted by Dow Chemical U.S.A., Midland, MI; CDL:250605-Z) |
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| 40098001 | Mayer, F.; Ellersieck, M. (1986) Manual of Acute Toxicity: Inter- pretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. US Fish & Wildlife Service, Resource Pub- lication 160. 579 p. |
| TN 23. TN 24, TN 28 and TN 48 (MRID 111461) | McCann, J.A. USEPA Beltsville Animal Biology tests with Bluegill sunfish- see Fed Lab Data |
| TN 32, TN 33, TN 34 | McCann, J.A. USEPA Beltsville Animal Biology tests with Rainbow trout and 24.9% ai product. - see Fed Lab Data |
| No MRID on DER | Mayer, F.L. 1982. Fathead minnow acute toxicity study. |
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| 51597 | McCann, J.A. (1974) Letter sent to Charles College dated Oct 22, 1974 ?Fish toxicity data\|. (U.S. Environmental Protection Agen- cy, Animal Biology Laboratory, unpublished study; CDL:224700-T) |

72-2 Acute Toxicity to Freshwater Invertebrates

| MRID | Citation Reference |
|---|---|

| | |
|---|---|
| 111510 - repeated | Kenaga, E. (1974) Letter sent to M. Adamczyk dated Aug 16, 1974 ?Weedone 2,4,5-TP\|. (Unpublished study received Oct 9, 1974 under 264-61; submitted by Dow Chemical U.S.A., Midland, MI; CDL:120636-A) |
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| 141979 | McCarty, W. (1977) Toxicity of 4-Amino-3,5,6-trichloropicolinic Acid, Picloram, to Daphnids: Final Report. Unpublished study prepared by Dow Chemical U.S.A. 8 p. |
| 151783 | Gersich, F.; Hopkins, D.; Milazzo, D. (1984) The Acute and Chronic Toxicity of Technical Picloram (4-Amino-3,5,6-trichloropicolinic acid) to Daphnia magna Straus: ES-690. Unpublished study pre- pared by Dow Chemical USA. 16 p. |
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| 45713401 | Boeri, R.; Wyskiel, D.; Ward, T. (2002) Picloram Acid: Acute Toxicity to the Gammarid, Gammarus pseudolimnaeus: Lab Project Number: 2390-DO: 021027. Unpublished study prepared by T.R. Wilbury Laboratories, Inc. 28 p. {OPPTS 850.1020} |
| 45765901 | Boeri, R.; Wyskiel, D.; Ward, T. (2002) Picloram Acid: Acute Toxicity to the Ramshorn Snail, Planorbella trivolvis: Lab Project Number: 2389-DO: 021028. Unpublished study prepared by T.R. Wilbury Laboratories, Inc. 27 p. |
| 40098001 | Mayer, F.; Ellersieck, M. (1986) Manual of Acute Toxicity: Inter- pretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. US Fish & Wildlife Service, Resource Pub- lication 160. 579 p. |
| 114875 MRID not on DER | Sanders, H.O. and O.B. Cope (1968) The Relative Toxicities of Several Pesticides to Naiads of Three Species of Stoneflies. Limnol. Oceanogr. 13:112-117. |
| 40094602 | Johnson, W.W. and M.T. Finley (1980) Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (U.S. Department of the Interior Fish and Wildlife Service, Resource Publication 137, Unpublished Report). |

72-3 Acute Toxicity to Estuarine/Marine Organisms

| MRID | Citation Reference |
|---|---|
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Fishery Investigations. U.S. Fish and Wildlife Service.

Estuarine species- not reviewed

72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

| MRID | Citation Reference |
|---|---|
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Statewide Monitoring of Picloram in West Va. 1984

Product Chemistry Summary

Residue Chemistry Summary

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| 128981 | Norris, L.; Montgomery, M.; Warren, L. (1976) Leaching and Persis- tence Characteristics of Picloram and 2,4-D on a Small Watershed in Southwest Oregon. (Presented at the 1976 Annual Meeting: Weed Science Society of America; Feb 5, 1976, Denver, CO; unpub- lished study received Jun 16, 1983 under 464-502; prepared in cooperation with U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station and others, submitted by Dow Chemi- cal U.S.A., Midland, MI; CDL:250518-F) |
| 128990 | Wright, W. (1974) The Movement of Herbicides off, into and through Soils of Two North Carolina Watersheds with Particular Reference to Picloram: Laboratory Report Code GH-P 874. Interim rept. (Unpublished study received Jun 16, 1983 under 464-502; submit- ted by Dow Chemical U.S.A., Midland, MI; CDL:250518-P) |

164-3 Forest field dissipation

| MRID | Citation Reference |
|---|---|
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| 128979 | Neary, D.; Douglass, J.; Fox, W. (1979) Low Picloram Concentrations in Streamflow Resulting from Forest Application of Tordon-10K. (Unpublished study received Jun 16, 1983 under 464-502; prepared by U.S. Forest Service, Southeastern Forest Experiment Station, Coweeta Hydrologic Laboratory, Range, |

Timber, and Wildlife, sub- mitted by Dow Chemical U.S.A., Midland, MI; CDL:250518-D)

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166-1 Ground water-small prospective

| MRID | Citation Reference |
| --- | --- |
| 45400701 | Havens, P.; Murrow, D.; Pottinger, M. (2001) State Groundwater Surveillance Monitoring Program for Picloram Herbicide: Field Progress Report: Lab Project Number: 980054: 96-330: ENV960714. Unpublished study prepared by Stone Environmental, Inc. and Agvise Laboratories. 861 p. |
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140319 Glass, B.L.; Edwards, W.M. (1973) Picloram in Lysimeter Runoff and Percolation Water. (Unpublished study received Mar 9, 1977 under 464-423; prepared by U.S. Agricultural Research Service, Agricultural Environmental Quality Institute and others, sub- mitted by Dow Chemical U.S.A., Midland, Mich.; CDL:228627-Q)

114837 or 22737 Corbin, F. (1965) The Influence of pH on the Detoxication of Herbi- cides in Soil. Doctoral thesis, North Carolina State Univ., Dept. of Crop Science. (Unpublished study received Mar 18, 1976 under 3E1385; submitted by U.S. Dept. of Interior, Bureau of Reclamation, Washington, DC; CDL:095210-N)

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111469 Davis, E.; Ingebo, P.; Pase, C. (1968) Effect of a Watershed Treat- ment with Picloram on Water Quality. ?S.l.|: U.S. Forest Service. (Research note RM-100; published study; CDL:120318-L)

128714 Dow Chemical U.S.A. (1983) Residue Chemistry: ?Tordon K Salt Liq- uor: Grains and Animal Tissue|. (Compilation; unpublished study received Jun 20, 1983 under 464-502; CDL:250508-A; 250509)

111554 West Virginia Dept. of Agriculture (1975) The Use of Tordon 10-K Herbicide to Control Multiflora Rose in Pastures in West Vir- ginia. Third quarterly rept. (Unpublished study; CDL:223586-A)

## Appendix B: Toxicity Comparison for Picloram Potassium Salt, 2,4-D TIPA Salt and Formulations Containing Both Picloram TIPA Salt and 2,4-D TIPA Salt

| Species | Formulation | % 2,4-D TIPA salt | % Picloram TIPA/K salt | ECx/ LCx (mg/kg or lbs/A) | 95% CI | Adj. EC50[1] | MRID |
|---|---|---|---|---|---|---|---|
| Green algae | 2,4-D TIPA salt only | 73.8 | NA | 75.7 | 31-160 | NA | 417321-01 |
| | Picloram TIPA salt +2,4-D TIPA salt | 39.6 | 10.2 | 234.0 | 179—305 | 130.7 | 414077-01 |
| | Picloram K salt | NA | 35.2 | 65.0 | 47—89 | 56.0 | 414077-02 |
| Freshwater diatom | 2,4-D TIPA salt only | 70.9 | NA | 94.4 | 60-148 | NA | 434886-01 |
| | Picloram TIPA salt +2,4-D TIPA salt | 21.2 | 10.2 | 400.0 | 320—500 | 223.0 | 432303-03 |
| | Picloram K salt | NA | 27.9 | 3.7 | 3.1—4.3 | 3.2 | 432303-02 |
| Blue-green algae | 2,4-D TIPA salt only | 70.9 | NA | 133.0 | 97-183 | NA | 434886-04 |
| | Picloram TIPA salt +2,4-D TIPA salt | 21.2 | 10.2 | 630.0 | 563—723 | 352.0 | 432303-09 |
| | Picloram K salt | NA | 27.9 | 585.0 | 536—647 | 504.0 | 432303-08 |
| Duckweed | 2,4-D TIPA salt only | 70.9 | NA | 2.37 | 1.9--2.9 | NA | 434886-02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Picloram TIPA salt +2,4-D TIPA salt | 39.6 | 9.7 | 4.67 | 2.59—8.42 | 2.61 | 432303-12 |
| | Picloram K salt | NA | 27.9 | 95.50 | 75—124 | 82.30 | 432303-11 |
| Rainbow Trout | 2,4-D TIPA salt only | 69.2 | NA | 300.00 | 268--323 | NA | 413538-03 |
| | Picloram TIPA salt +2,4-D TIPA salt | 40.8 | 2.5 | 1250.00 | | 698.32 | 41146 |
| | Picloram K salt | NA | 24.4 | 26.00 | | 22.40 | 129072 |
| Terrestrial Plants-Veg Vigor—Dicot (Tomato) | **2,4-D DMA Salt** | 39.3% | NA | 0.0073 | 0.0045—0.0126 | | 471060-02 |
| | Picloram TIPA salt +2,4-D TIPA salt | 22.4% | 6.1% | 0.0002 | | | 412965-01 |
| | Picloram K salt | NA | 24.1% | 0.00018 | 0.0047—0.095 | | 441567-01 |
| Terrestrial Plants-Seedling Emergence (Tomato) | **2,4-D DMA Salt** | 55.5% | NA | 0.26 | NA | | 423895-01 |
| | Picloram TIPA salt +2,4-D TIPA salt | 22.4% | 6.1% | 0.00036 | NA | | 412965-01 (**Qualitative Data)** |
| | Picloram K salt | NA | 24.1% | 0.0066 | 0.0047-0.095 | | 439595-05 |

[1]Adjusted LC/$EC_{50}$ is based on acid equivalents for picloram acid using a molecular weight ratio of 1.79 for the picloram TIPA salt and 1.16 for the picloram potassium salt.
NA = Not Applicable

EFED conducted an analysis comparing the toxicity of formulations containing either picloram K salt or 2,4-D TIPA salt with multi-ai data from formulations containing both picloram TIPA salt and 2,4-D TIPA salt in order to see if the combination of multiple herbicides had enhanced toxicity.  For taxa where data was available on these three formulations (including aquatic plants, aquatic invertebrates and fish), there was no evidence of enhanced toxicity from the picloram and 2,4-D TIPA salts mixture. However, no data was available for the effect of formulations solely containing one active ingredient of 2,4-D TIPA salt on terrestrial plants. In this case, EFED used 2,4-D DMA salt as a comparison, which was identified as the most toxic 2,4-D salt to dicots in the 2013 2,4-D Problem Formulation (USEPA, 2013). The most sensitive terrestrial plant species for which data was available for both picloram salts and 2,4-D DMA salt was the tomato. Although there was no evidence of enhanced toxicity in the vegetative vigor studies, for the seedling emergence studies the tomato was an order of magnitude more sensitive to the picloram/2-4 D TIPA salts formulation than the picloram K salt formulation and 4 orders of magnitude more sensitive than the 2,4-D DMA salt formulation. The same qualitative data source (MRID 412965-01) used for the picloram TIPA salt and 2,4-D TIPA salt co-formulation also contained qualitative information for picloram K salt that was more sensitive than the quantitative data cited above, however it was still less sensitive than the picloram TIPA salt/2,4-D TIPA salt co-formulation data..

## Appendix C: Summary Data for Picloram Related Incidents (PC Codes 005101, 005102, 005104)

# EIIS Pesticide Summary Report: General Information

**Picloram (005101)**

| Incident # | Date | County | State | Certainty | Legal. | Formul. | Appl. Method | Total Magnitude |
|---|---|---|---|---|---|---|---|---|
| **AQUATIC** | | | | | | | | |
| *Agricultural Area* | | | | | | | | |
| I001616-001 | 11/23/1994 | | | 4 | RU | EC | N/R | 1 |
| *N/R* | | | | | | | | |
| I003325-001 | | | | 2 | MA | | Spray | 105 |
| *WEEDS NEAR POND* | | | | | | | | |
| I007873-001 | 8/21/1998 | | TX | 2 | MA | | N/R | 300 |
| **PLANTS** | | | | | | | | |
| *No Data* | | | | | | | | |
| I020998-034 | 3/21/2003 | Chelan | WA | 2 | UN | | | |
| I021276-012 | 4/15/2004 | Spokane | WA | 2 | M | | | |
| *Agricultural area* | | | | | | | | |
| I020627-009 | | Spokane | WA | 3 | RU | | | 3 acres |
| I001458-001 | | | | 3 | UN | N/R | N/R | 90 ACRES OF POTATO'S |
| I004815-001 | | | MO | 3 | UN | | Spray | 40 ACRES SOYBEANS |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I002168-001 | 5/1/1995 | | FL | 3 | MA | F | Broadcast, unincorporated | Unknown |
| | I003129-001 | 1/1/1996 | | KS | 3 | RU | N/R | N/R | ALL |
| | I008333-002 | 7/4/1997 | YELLOWSTONE | MT | 2 | RU | N/R | FOLIAR BROADCAST | 2600 ACRES |
| | I008333-004 | 4/21/1998 | JEWELL | KS | 3 | RU | F | Broadcast | 228 ACRES |
| | I007754-003 | 4/28/1998 | GOODHUE | MN | 2 | RU | | Broadcast | 80 ACRES |
| | I015921-002 | 8/6/2003 | Osage | OK | 2 | UN | | Spray | Trees (hundreds) |
| *Garden* | | | | | | | | | |
| | I013587-027 | 6/21/1999 | Spokane | WA | 3 | RU | | | Unknown |
| *Hay* | | | | | | | | | |
| | I015748-001 | | Culpeper | VA | 2 | RU | | Broadcast | 10.2 acres |
| *HOME/LAWN* | | | | | | | | | |
| | I006281-001 | 6/1/1997 | | KS | 3 | RU | N/R | N/R | 9 |
| *Municpal operation* | | | | | | | | | |
| | I007708-001 | 3/1/1997 | BROWN | OH | 2 | UN | | N/R | UNKNOWN |
| | I008451-001 | 12/7/1998 | ROANOKE | VA | 3 | RU | | N/R | UNKNOWN |
| *N/R* | | | | | | | | | |
| | I002324-001 | 6/1/1995 | | PA | 3 | UN | N/R | SPRAY | N/R |
| | I020627-039 | 10/24/2001 | Yakima | WA | 2 | UN | | | |
| *Pasture* | | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I011249-001 | 6/17/2000 | Webster | NE | 2 | RU | SC | Spray | UNKNOWN |
| *Right-of-way* | | | | | | | | |
| I020459-008 | | Okanogan | WA | 2 | UN | | Spray | |
| I006871-001 | | | OH | 3 | RU | | N/R | UNKNOWN |
| I001944-001 | | | OK | 2 | MA | | Spray | HUNDREDS OF TREES |
| I002539-001 | 8/1/1995 | | OK | 2 | UN | N/R | SPRAY | 1 1/3 AR |
| I013884-039 | 8/25/1998 | Spokane | WA | 2 | MA | | | One tree |
| I015218-001 | 7/15/2004 | Massac | IL | 1 | RU | | Spray | 50-75 trees |
| *Right-of-way, railroad* | | | | | | | | |
| I004352-001 | | | OK | 4 | MA | | | 50000 |
| *WHEAT* | | | | | | | | |
| I004819-001 | | | KS | 3 | RU | | N/R | UNKNOWN |
| I008333-001 | 6/25/1998 | OSBORNE | KS | 2 | MA | N/R | Broadcast | 40 ACRES |

**TERRESTRIAL**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Turf, residential* | | | | | | | | |
| I023571-002 | 7/12/5010 | Klamath | OR | 2 | M | | Spray | Over 1000 |

**TERRESTRIAL/AQUATIC**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *N/R* | | | | | | | | |
| I006139-001 | 10/1/1997 | | OK | 2 | UN | N/R | N/R | UNKNOWN |

# EIIS Pesticide Summary Report: General Information

## Picloram, triisopropanolamine salt (005102)

| | Incident # | Date | County | State | Certainty | Legal. | Formul. | Appl. Method | Total Magnitude |
|---|---|---|---|---|---|---|---|---|---|
| **PLANTS** | | | | | | | | | |
| *Brome* | | | | | | | | | |
| | I012366-045 | 7/27/2000 | MORRIS | KS | 3 | RU | | Broadcast | 500 acres |
| *Hay* | | | | | | | | | |
| | I012366-047 | 4/25/2000 | LONOKE | AR | 2 | RU | | Broadcast | 42 acres |
| | I010624-001 | 8/1/2000 | Whitman | WA | 3 | RU | N/R | N/R | |
| | I014702-019 | 4/28/2003 | Cass | MS | 2 | RU | SC | Broadcast | 40 acres |
| | I018930-031 | 5/5/2007 | Tarrant | TX | 2 | MA | | | 2 acres |
| *N/R* | | | | | | | | | |
| | I014561-012 | 10/8/2003 | Harris | TX | 2 | UN | EC | | Various |
| *Pasture* | | | | | | | | | |
| | I014702-018 | | Lawrence | MO | 2 | RU | SC | Broadcast | 60 acres |
| | I012366-046 | 8/14/2000 | JEFFERSON | TX | 3 | RU | | Broadcast | 30 acres |
| | I014034-009 | 4/29/2003 | Hall | GA | 2 | RU | | | 60 acres |
| *Peanut* | | | | | | | | | |
| | I013550-001 | 6/19/2002 | KLEBERG | TX | 3 | MA | | | 360 acres |
| *RANGELAND* | | | | | | | | | |



Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

# EIIS Pesticide Summary Report: General Information

## Picloram, potassium salt (005104)

| Incident # | Date | County | State | Certainty | Legal. | Formul. | Appl. Method | Total Magnitude |
|---|---|---|---|---|---|---|---|---|
| **AQUATIC** | | | | | | | | |
| *Fence row* | | | | | | | | |
| I000046-001 | 7/21/1989 | MADISON | MT | 3 | RU | N/R | Spray | THOUSANDS |
| **PLANTS** | | | | | | | | |
| *Corn* | | | | | | | | |
| I012366-078 | 6/14/2000 | GREELEY | KS | 3 | M | | Broadcast | 130 acres |
| *Hay* | | | | | | | | |
| I018677-001 | 6/2/2007 | Rappahannock | VA | 4 | UN | | Spray | 10 acres |
| *Orchard (unspecified)* | | | | | | | | |
| I020459-002 | | Chelan | WA | 3 | UN | | | |
| *Peanut* | | | | | | | | |
| I013550-001 | 6/19/2002 | KLEBERG | TX | 3 | MA | | | 360 acres |
| *Unknown* | | | | | | | | |
| I014702-077 | 7/20/2003 | Ford | KS | 2 | RU | EC | Broadcast | 351 acres |
| *Wheat* | | | | | | | | |
| I012366-079 | 6/11/1999 | PAWNEE | KS | 3 | RU | | Broadcast | 38 acres |
| I012366-076 | 6/20/2000 | Ward | ND | 3 | RU | | Broadcast | 120 acres |



Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

# Appendix D- SIP and STIR Outputs

**STIR**

| Input | |
|---|---|
| **Application and Chemical Information** | |
| Enter Chemical Name | Picloram |
| Enter Chemical Use | Rights-of-way, pasture |
| Is the Application a Spray? (enter y or n) | y |
| If Spray What Type (enter ground or air) | air |
| Enter Chemical Molecular Weight (g/mole) | 241.5 |
| Enter Chemical Vapor Pressure (mmHg) | |
| Enter Application Rate (lb a.i./acre) | |
| **Toxicity Properties** | |
| ***Bird*** | |
| Enter Lowest Bird Oral $LD_{50}$ (mg/kg bw) | 2150 |
| Enter Mineau Scaling Factor | 1.15 |
| Enter Tested Bird Weight (kg) | 1.58 |
| ***Mammal*** | |
| Enter Lowest Rat Oral $LD_{50}$ (mg/kg bw) | 3536 |
| Enter Lowest Rat Inhalation $LC_{50}$ (mg/L) | 0.035 |
| Duration of Rat Inhalation Study (hrs) | 4 |
| Enter Rat Weight (kg) | 0.35 |

## Output

| Results Avian (0.020 kg ) | | |
|---|---|---|
| Maximum Vapor Concentration in Air at Saturation ($mg/m^3$) | 0.00E+00 | |
| Maximum 1-hour Vapor Inhalation Dose (mg/kg) | 0.00E+00 | |
| Adjusted Inhalation $LD_{50}$ | 8.55E-02 | |
| Ratio of Vapor Dose to Adjusted Inhalation $LD_{50}$ | 0.00E+00 | **Exposure not Likely Significant** |
| Maximum Post-treatment Spray Inhalation Dose (mg/kg) | 0.00E+00 | |
| Ratio of Droplet Inhalation Dose to Adjusted Inhalation $LD_{50}$ | 0.00E+00 | **Exposure not Likely Significant** |

| Results Mammalian (0.015 kg ) | | |
|---|---|---|
| Maximum Vapor Concentration in Air at Saturation ($mg/m^3$) | 0.00E+00 | |
| Maximum 1-hour Vapor Inhalation Dose (mg/kg) | 0.00E+00 | |
| Adjusted Inhalation $LD_{50}$ | 2.08E+00 | |
| Ratio of Vapor Dose to Adjusted Inhalation $LD_{50}$ | 0.00E+00 | **Exposure not Likely Significant** |
| Maximum Post-treatment Spray Inhalation Dose (mg/kg) | 0.00E+00 | |
| Ratio of Droplet Inhalation Dose to Adjusted Inhalation $LD_{50}$ | 0.00E+00 | **Exposure not Likely Significant** |

## SIP

**Table 1. Inputs**

| Parameter | Value |
|---|---|
| Chemical name | Picloram |
| Solubility (in water at 25°C; mg/L) | 430 |
| | |
| Mammalian $LD_{50}$ (mg/kg-bw) | 3536 |
| Mammalian test species | laboratory rat |
| Body weight (g) of "other" mammalian species | |
| | |
| Mammalian NOAEL (mg/kg-bw) | 200 |

| | |
|---|---|
| Mammalian test species | laboratory rat |
| Body weight (g) of "other" mammalian species | |
| | |
| Avian $LD_{50}$ (mg/kg-bw) | 2510 |
| Avian test species | mallard duck |
| Body weight (g) of "other" avian species | |
| Mineau scaling factor | 1.15 |
| | |
| Mallard NOAEC (mg/kg-diet) | 0 |
| Bobwhite quail NOAEC (mg/kg-diet) | 0 |
| NOAEC (mg/kg-diet) for other bird species | 0 |
| Body weight (g) of other avian species | |
| NOAEC (mg/kg-diet) for 2nd other bird species | |
| Body weight (g) of 2nd other avian species | |

**Table 2. Mammalian Results**

| **Parameter** | **Acute** | **Chronic** |
|---|---|---|
| Upper bound exposure (mg/kg-bw) | 73.9600 | 73.9600 |
| Adjusted toxicity value (mg/kg-bw) | 2719.7518 | 153.8321 |
| Ratio of exposure to toxicity | 0.0272 | 0.4808 |
| Conclusion* | **Drinking water exposure alone is NOT a potential concern for mammals** | **Drinking water exposure alone is NOT a potential concern for mammals** |

**Table 3. Avian Results**

| **Parameter** | **Acute** | **Chronic** |
|---|---|---|
| Upper bound exposure (mg/kg-bw) | 348.3000 | 348.3000 |
| Adjusted toxicity value (mg/kg-bw) | 1303.2558 | 0.0000 |
| Ratio of exposure to acute toxicity | 0.2673 | 0.0000 |

| | | |
|---|---|---|
| Conclusion* | **Exposure through drinking water alone is a potential concern for birds** | **Due to insufficient data, risk cannot be precluded** |

*Conclusion is for drinking water exposure alone. This does not combine all routes of exposure. Therefore, when aggregated with other routes (*i.e.*, diet, inhalation, dermal), pesticide exposure through drinking water may contribute to a total exposure that has potential for effects to non-target animals.